SAE Journal

DECEMBER 1959

IN THIS ISSUE . . .

Published by The Society of Automotive Engineers

2 reasons why engines get more power protection from Perfect Circle

1. PERFECT CIRCLE CHROME RINGS

solve problem of excessive oil consumption past pistons!

P C chrome piston rings are the finest obtainable! Top rings and oil rings are plated with thick, solid chrome. Entire area of ring travel gets complete wear protection, more than doubling life of cylinders, rings, pistons. No tedious break-in is necessary because rings are pre-seated at factory.

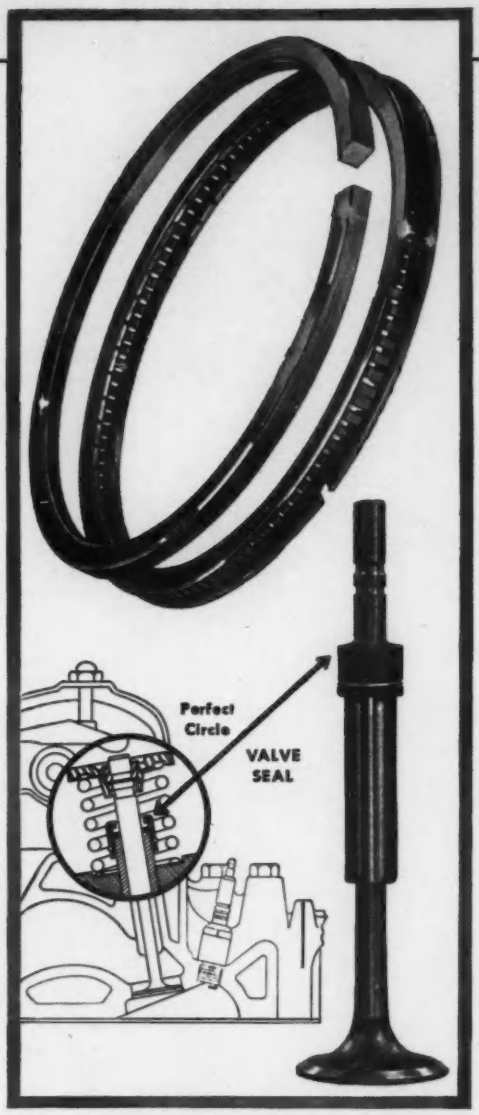
SPECIFY P C CHROME RINGS for thousands of extra miles of power protection with positive oil control!

2. PERFECT CIRCLE VALVE SEALS

solve problem of excessive oil consumption past valves!

New overhead valve engines develop higher compression pressures...and higher deceleration vacuum. Increased vacuum draws oil through loose or worn valve guides. Avoid this oil loss with new Perfect Circle Valve Seals!

SPECIFY PERFECT CIRCLE VALVE SEALS to control oil loss through valve guides in overhead valve engines.



PERFECT CIRCLE

PISTON RINGS AND POWER SERVICE PRODUCTS

Hagerstown, Indiana

Don Mills, Ontario, Canada

SAE Journal

Society of Automotive Engineers

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Publication Office
10 McGovern Ave., Lancaster, Pa.

Society Headquarters
Editorial and Advertising Office
485 Lexington Ave., New York 17, N. Y.
Tel: OXford 7-3340; Teletype: NY1 228

Detroit Branch manager, G. J. Gaudaen
635 New Center Bldg., Detroit 2, Mich.
Tel: TRinity 1-1772; Teletype: DE 826

Western Branch manager, E. W. Rentz, Jr.
714 W. Olympic Blvd., Los Angeles 15, Cal.
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ADVERTISING OFFICES

advertising sales manager, Edward D. Boyer
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Briefs of SAE PAPERS

Presented here are brief digests of recently presented SAE papers. These papers are available in full in multilith form for one year after presentation. To order, circle the numbers in the "Readers Information Service" blank on page 6 corresponding to the numbers appearing after the titles of the digests of interest to you.

FUELS & LUBRICANTS

Lubrication, and Its Effect on Maintenance, L. C. ATCHISON, R. McBRIAN. Paper No. 84T. Lubrication of heat engines; three functions of oil are lubricating moving parts, cooling, transferring heat from hotter parts to some location where it can be lost, and transporting fuel wastes to oil filter where they can be removed; role of fuel oil additives.

Marine Engine Octane Rating Program, R. A. WELLS, M. J. BOEGEL, J. C. VOLLMER. Paper No. 83T. Objectives of Gulf Research & Development Co.'s program; engineering data accumulated from tests during 1956–59 program where 65 engines of 16 different models produced by seven different manufacturers were tested under various conditions; outboard motors having low octane requirement engines were not part of program; recommendations made to obtain better marine engine operation.

GROUND VEHICLES

Automotive Electrical Requirements for Logging Industry, H. A. BRISCHLE. Paper No. 85T. Types of logging and construction equipment used, such as trucks, trailers, tractors, earthmovers, etc, and problem of keeping adequate replacement stock of electric components (batteries, generators, starters, voltage regulators, etc) in remote forest and logging areas; standardization program is proposed and needs of logging and construction industry outlined; recommendations.

Parking and Emergency Brakes, J. L. MILLER. Paper No. 88T. Development of parking brake that could also be used as emergency brake by MGM Brakes, Inc.; basically, spring brake is simple spring loaded cylinder using air pressure to compress springs; they must be engineered to vehicle and to job; on conventional combinations of 76,000 GCW, spring brakes working on two conventional 16 × 7 in. brake drums afford ample parking ability for most jobs.

Compaction Equipment and It's Competence to Meet Construction Standards, E. M. SMITH. Paper No. 89V. Features and faults with respect to basic designs of following equipment: flat steel wheeled rollers, tamping roller or sheepsfoot, wobbly wheel, towed or self propelled type, heavy rubber tired rollers of 25–200 tons, and pan type vibrator and internal vibrating steel drum rollers; use of extremely heavy rubber tired rollers for compaction of all types of soils and development of all purpose roller recommended.

Performance and Design of Modern Tractor-Mounted Rippers, C. R. FAHNESTOCK. Paper No. 90T. Application, economics and future of heavy duty tractor ripper which makes it possible to rip and scraper-load materials that formerly had to be drilled and blasted; comparison of ripping and blasting methods in relation to utilization of equipment available; end use of material, and method of transporting it; important design factors in performance are type of linkage, selection of design load, ripping angle and depth, point design, and properly matched hydraulic components.

Hydrostatic Transmissions, P. C. MORTENSON. Paper No. 92U. Fundamentals of fluid transmission; general characteristics and unresolved problems; operational and efficiency characteristics; consideration of two basic types of transmissions, first consisting of variable pump and fixed motor, and second of fixed pump and variable motor; it is also possible to use two variable displacement units; appli-

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SAE JOURNAL, December, 1959, Vol. 67, No. 12. Published monthly except two issues in January by the Society of Automotive Engineers, Inc. Publication office at 10 McGovern Ave., Lancaster, Pa. Editorial and advertising department at the headquarters of the Society, 485 Lexington Ave., New York 17, N. Y. $1 per number; $12 per year; foreign $14 per year; to members 50¢ per number, $5 per year. Entered as second class matter, Sept. 15, 1948, at the Post Office at Lancaster, Pa., under the Act of Aug. 24, 1912. Acceptance for mailing at special rate of postage provided for in the Act of Feb. 28, 1925, embodied in paragraph (d-2), Sec. 34.40, P. L. and R., of 1918. Additional entry at New York, N. Y. Second class postage paid at Lancaster, Pa. and additional office N. Y. C.

Briefs of SAE PAPERS

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cability to farm tractors, combine, and lift truck.

Air Cleaners — Dry or Oil Bath, S. T. McCORMICK. Paper No. 85V. Review of development of air cleaners; description, advantages and disadvantages of strainer and cyclone type dry cleaner; viscous impingement cleaner; oil bath air cleaner and combination cleaners.

Electric Drive for Off-Highway Vehicles, H. J. McLEAN, H. VITT. Paper No. 92T. Study made by General Electric Co. to develop transmission for rugged traction equipment; definition of requirements; traction motor drive that eliminates need for mechanical drive lines, differentials and hydraulic torque converters is designed to provide 60% adhesion on all wheels at standstill and full horsepower utilization over most of speed range to max of 35 mph; motor output characteristic and arrangements; analysis of performance.

Role of Mechanization in Soviet Agriculture, K. D. BUTLER. Paper No. 93T. Extent of collectivization and agricultural production; soil and climatic conditions; corn production; use of electric power on farms; farm equipment industry; tractor repair stations; mechanization and manpower requirements; means of farm transportation; comparison between farm policy of Soviet Union and United States; immediate goals and new 7-yr plan, 1959–1965.

Soviet Agricultural Tractors and Equipment, W. H. WORTHINGTON. Paper No. 93U. Appraisal and evaluation of progress and rate of progress; classes of existing farm tractors; present production wheel and diesel tractors, ranging from 18–54 hp; new models intended for 1959 production; current Soviet wheel type farm tractors; track laying farm tractors; new developments such as 4-cyl 40-hp air cooled engine D50, 4-cyl diesel engine developing 55 hp at 1500 rpm, etc; illustrations, schematics, tables.

Recent Developments in Power Take-Off Drives for Agricultural Tractors and Implements, M. E. HANSEN. Paper No. 95T. Progress report covering programs under study by Farm Equipment Inst. Advisory Eng. Committee, Am. Soc. Agricultural Engrs, Power & Machinery Committee, SAE Tractor Committee; list of "Standards" and "Recommendations" applying to PTO drive; improved hitch connection between tractor and implement; improvement in fastening for forward universal joint to tractor PTO shaft; standard covering PTO drive shaft assembly; telescoping of power line between tractor and implement; 1000 rpm PTO program.

Strength Considerations in Agricultural Drive Lines, M. A. ERICKSON. Paper No. 95U. Factors to consider in selection of materials; use of strain gage torquemeter and recording equipment for measuring torques in drive lines under field operation; drive line load protective devices; development of 60-in. rotary field cutter with and without implement torque limiting clutch; test results and strength analysis made on basis of maximum torque and bending moment occurring simultaneously.

Safety Shielding for Agricultural Power Take-Off Drives, R. E. HARRINGTON, C. S. MORRISON. Paper No. 95W. Accident rate comparison shows that fatal accidents involving PTO drives totaled approximately 65 in 1958 or about 6% of all of farm equipment deaths; existing shield types, removable and nonremovable, and experience made with integral rotating shields which revealed desirable requirements for adequate shielding; results of shielding survey; effect of industry standards on shielding problem.

Mechanical Hitch with Hydraulic Transport, L. H. HODGES, C. E. HENSON, R. W. BUSHMEYER. Paper No. 96T. Concept of design, wherein each element of tractor and implement is engineered to enhance overall performance of unit, developed by J. I. Case

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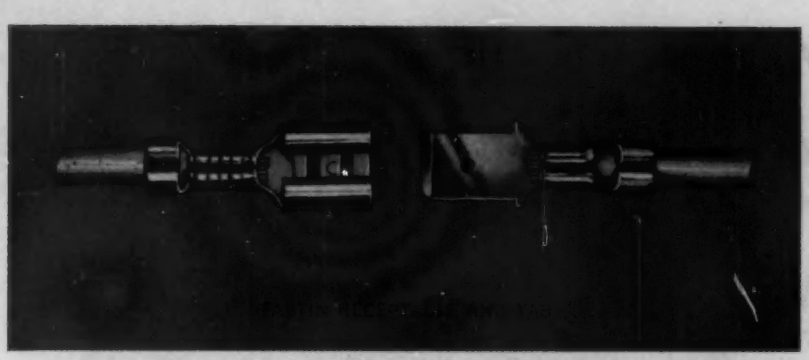

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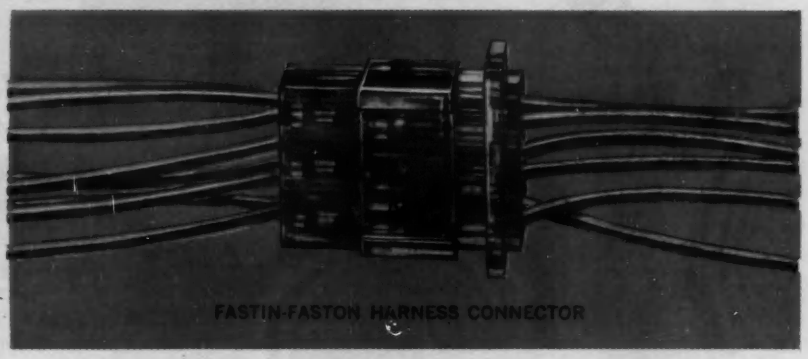

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Announcing!

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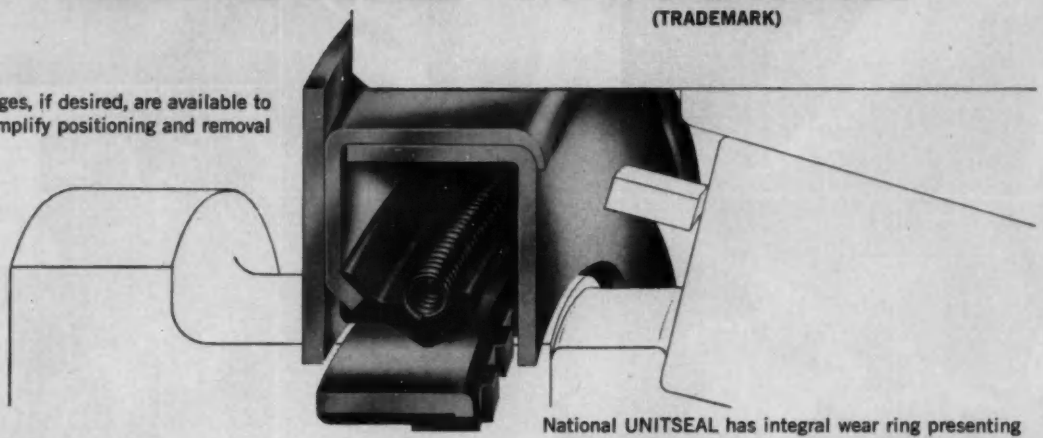
(TRADEMARK)



National UNITSEAL has integral wear ring presenting rubber surface to shaft. Wear ring turns with shaft, sealing lip is never exposed to damage, cannot score shaft.

A new unitized oil-seal-and-wear ring that eliminates:

SHAFT WEAR OR SCORING

SEPARATE METAL WEAR SLEEVES

EXPENSIVE SHAFT FINISHES

COSTLY SHAFT RE-MACHINING

SEALING LIP INSTALLATION DAMAGE

SPECIAL INSTALLATION PROCEDURES

New National UNITSEAL is now in production, in a limited range of sizes, for heavy oil and grease sealing applications — including truck, bus and tractor uses. Still newer UNITSEALS are on the way for higher speed automotive and similar uses.

Changing a National UNITSEAL automatically changes the wear sleeve — in one fast operation. Since the seal has its own integral wear ring, it is almost impossible to install it other than squarely on the shaft. Expensive shaft finishing is no longer a necessity, nor is leakage under a metal wear ring a problem—both thanks to the rubber surface UNITSEAL presents to the shaft.

Get complete details today; write direct, or call your National Seal Applications Engineer. He's in the Yellow Pages, under Oil Seals.

NATIONAL SEAL

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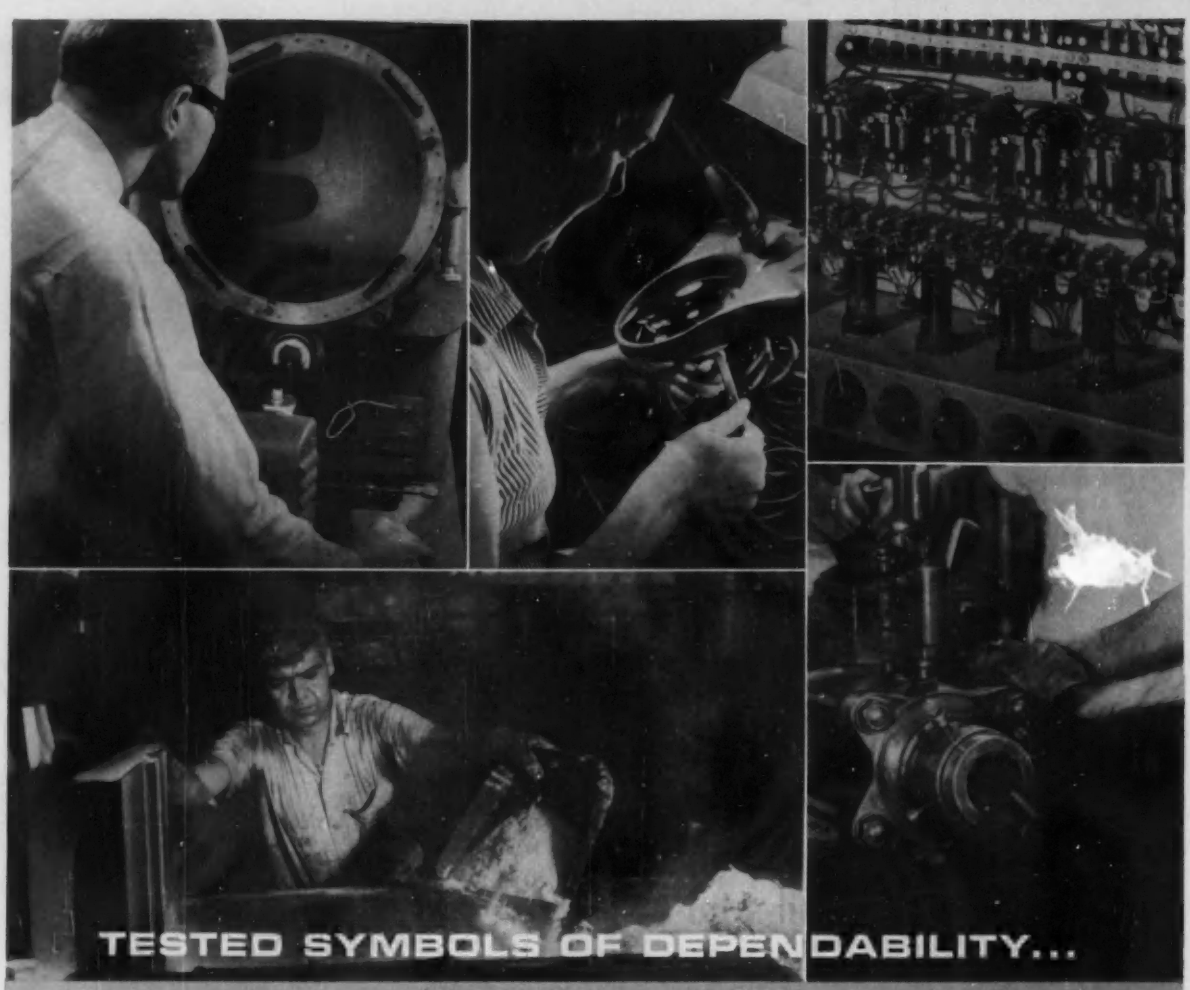

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At Plastic and Rubber Products Company each production process used in the manufacture of exacting rubber products is symbolic of ultimate quality and dependability. Each has been tested and proved for years to attain this symbolic stature. Each contributes a maximum to ultimate customer satisfaction—the final criterion of product quality.

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Mixing is scientifically performed. All ingredients are laboratory tested and combined according to recipe. Only after each mix is laboratory analyzed is it released for production.

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PLASTIC AND RUBBER PRODUCTS COMPANY

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KNOW YOUR ALLOY STEELS...

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

How Heat-Treatment Affects Alloy Steels

Heat-treatment may be defined as an operation or series of operations involving the heating and cooling of steel in the solid state to develop the required properties. There are in general five different forms of heat-treatment used with alloy steel. These treatments modify the mechanical properties of the steel to suit the end use.

The five forms of treatment mentioned above, as applied to constructional alloy steels, are discussed in the following paragraphs:

(1) *Quenching and Tempering.* This form of heat-treatment usually consists of three successive operations: (a) heating the steel above the critical range, so that it approaches a uniform solid solution; (b) hardening the steel by quenching it in oil, water, brine, or salt; and (c) tempering the steel by reheating it to a point below the critical range in order to effect the proper combination of strength and ductility.

(2) *Normalizing.* A form of treatment in which the steel is heated to a predetermined temperature above the critical range, after which it is cooled to below the range in still air. The purpose of normalizing is to promote uniformity of structure and to alter mechanical properties.

(3) *Annealing.* This method consists of heating the steel to a point at or near the critical range, then cooling at a predetermined slow rate. Annealing is used to soften the steel, to improve machinability, to reduce stresses, to improve or restore ductility, and to modify other properties.

(4) *Spheroidize-Annealing.* This form of heat-treating requires prolonged heating of steel at an appropriate temperature, followed by slow cooling to produce a globular condition of the carbide. This treatment produces a structure which may be desirable for machining, cold-forming, or cold-drawing, or for the effect it will have on subsequent heat-treatment.

(5) *Stress-Relieving.* This is the process of reducing internal stresses by heating the steel to a temperature below the critical range, and holding for a time interval sufficient to equalize the temperature throughout the piece. The object of this treatment is to restore the elastic properties of the steel, or to reduce stresses that may have been induced by machining, cold-working, or welding.

Each of the five forms of heat-treatment will be the subject of a future advertisement.

Bethlehem metallurgists have had long experience in all methods of heat-treatment. They understand the possibilities and limitations of each method with respect to various alloy steels. These men will be glad to help you with any problems concerning heat-treatment. Feel free to ask for their services.

And call on Bethlehem, too, for the full range of AISI standard alloy steels, as well as special-analysis steels and all carbon grades. We can meet your needs promptly.

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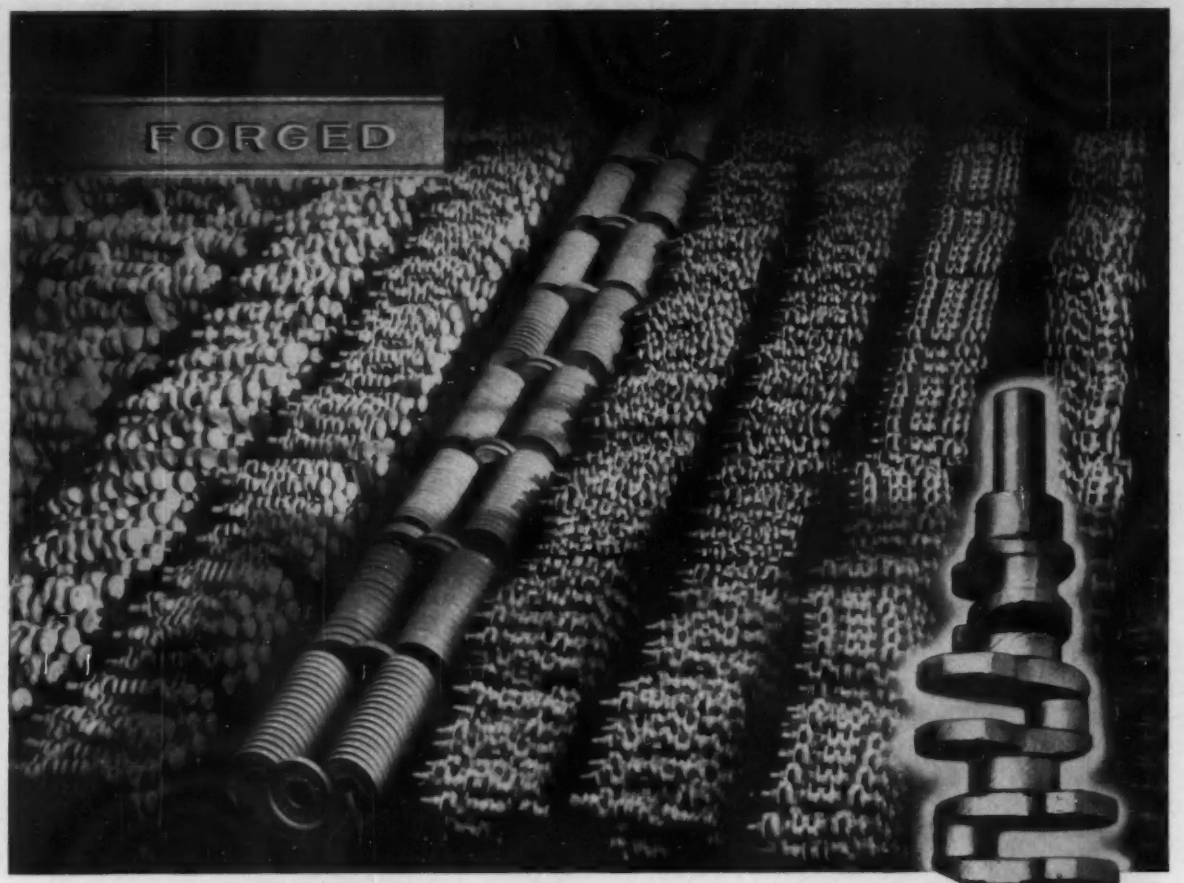
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL



On their way to move men, merchandise—or mountains

For a nation on wheels and on the wing—a production run of forged crankshafts and jet engine compressor wheels for the builders of power-plants for pleasure cars, trucks, earth-moving equipment, and aircraft.

In missile development, too, Wyman-Gordon has proved the value of forging in achieving the highest strength-weight ratios, at elevated temperatures.

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EST. 1883

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SILICONE NEWS from Dow Corning

Rubber Stays Flexible at 500F

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For an elastomer that must seal hot air and contact hot metal, try Silastic, the Dow Corning silicone rubber. Engineers at LeTourneau-Westinghouse were so impressed with their tests of Silastic that they have now standardized on it for brake actuating diaphragms in all their 20 to 70 ton Tournapull earth movers.

These Tournapulls require an extremely high braking force to bring them to a stop. Their disc brakes must absorb up to 1700 BTU per second of heat energy . . . brake area temperatures may frequently rise to above 500 F. As a result, the brake diaphragms formerly used failed too often.

So LeTourneau engineers started a laboratory and field evaluation program of other diaphragm materials, including Silastic reinforced with glass cloth. They found that the diaphragms of Silastic repeatedly withstood 100,000 half-inch flexings while intermittently subjected to temperatures in the range of 500 F. Even after this rough treatment, the Silastic retained its original shape, strength and flexibility. The diaphragms of Silastic have provided five times the service life of the previously used parts.

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TYPICAL PROPERTIES OF SILASTIC
(non-reinforced)

Temperature Range, °F	130 to 500
Tensile Strength, psi	600 to 1500
Tear Strength, lb./in.	40 to 180
Elongation, %	150 to 400
Compression Set, %, @ 300 F	5 to 50
Hardness Range, Shore A	25 to 80

If you consider *all* the properties of a silicone rubber, you'll *specify Silastic.*

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

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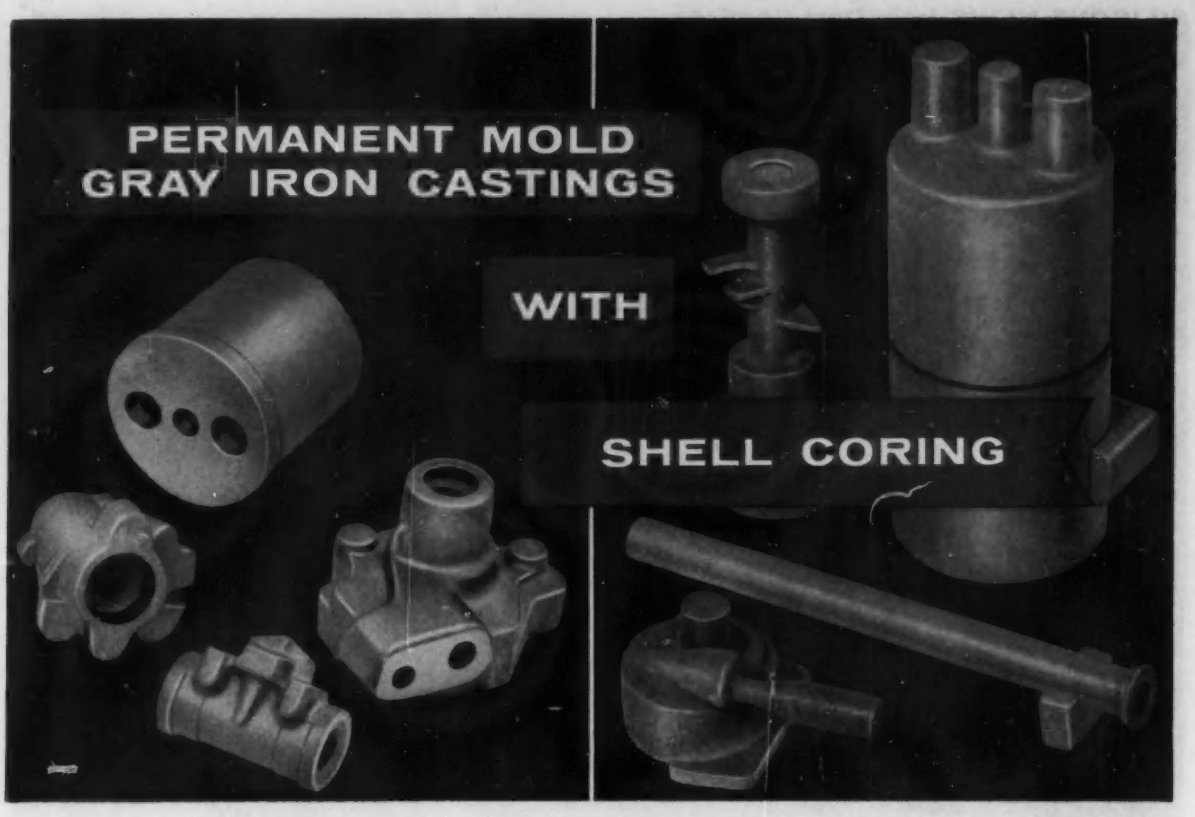

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- ★ Excellent tensile strength
- ★ Ability to take high surface finishes
- ★ Freedom from leakage under pressure

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transport ENGINES

OVER THE ROAD OR OFF THE HIGHWAY

the BEST in all three!

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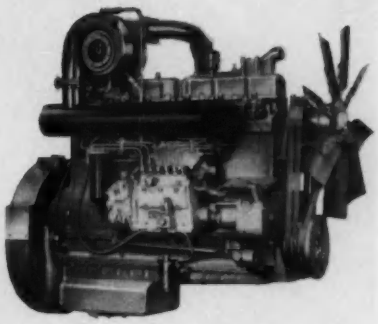

Normal or Turbocharged DIESELS from 60 to 350 hp.
Model shown is 148-DKBS—280 max. hp. 5¼ x 6 bore and stroke—779 cu. in. displacement.

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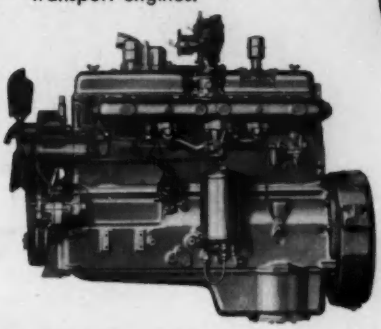

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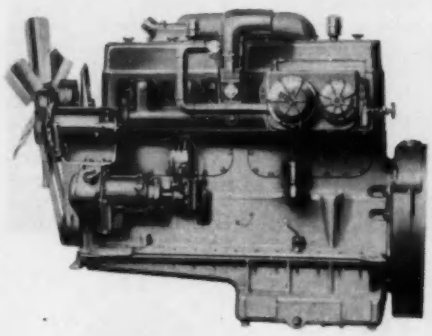
. . . those tremendous, crushing 30-ton, 35-ton, 40-ton loads . . . up stiff grades, without faltering or breakdown . . . day after day—with Waukesha.



BUTANE-PROPANE Engines from 40 to 300 max. hp.
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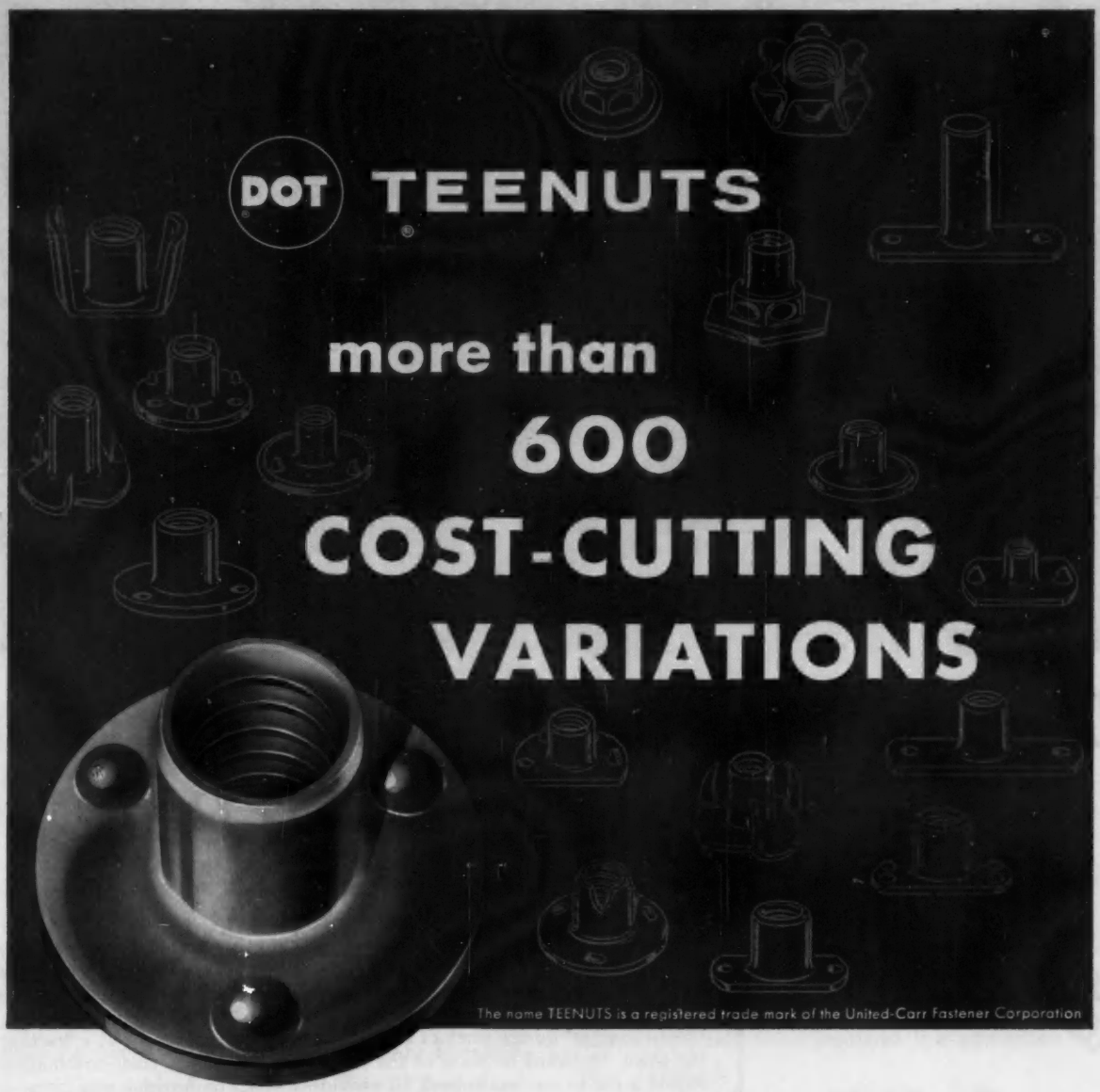

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Wide experience in the proper application of DOT TEENUTS and a multitude of other special-purpose fasteners enables your DOT field representative to provide prompt and effective solutions to a tremendous variety of fastening problems. Where special design work is needed, he can bring you the services of a design-engineering group unequalled in its field.

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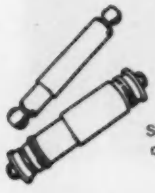

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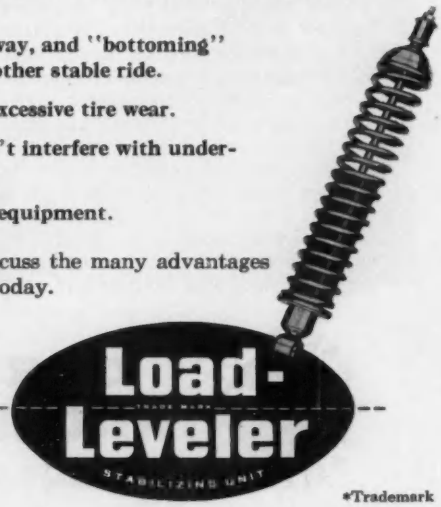

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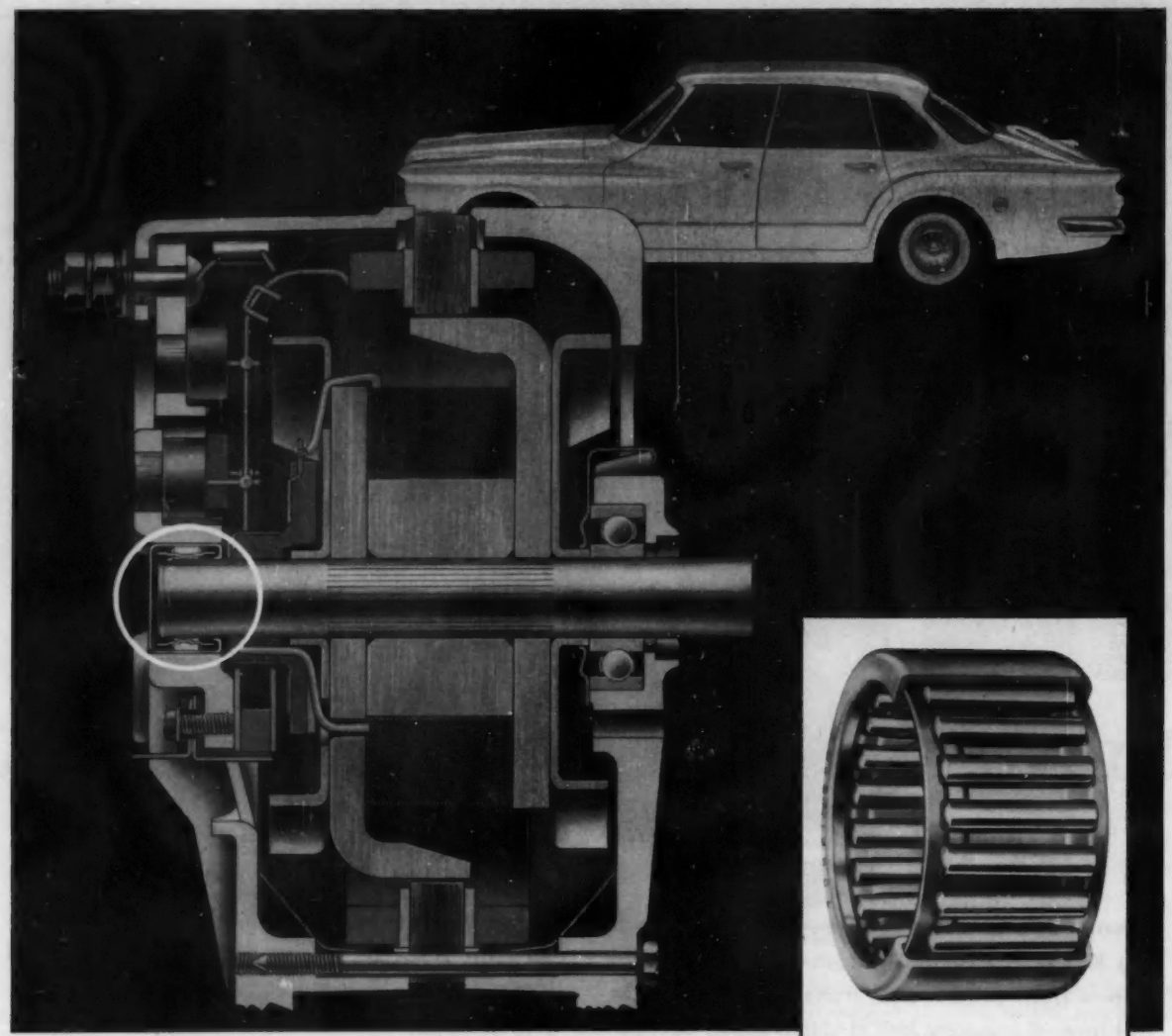

Torrington Drawn Cup Roller Bearings Used in Valiant's Alternator

Compactness, efficiency, economy, reliability . . . these are outstanding features of Chrysler Corporation's exciting new small car . . . and of Torrington Drawn Cup Roller Bearings. Used by Chrysler in the Valiant's new alternator system for electrical power generation, these bearings provide smooth, trouble-free operation and long service life without need for relubrication.

Torrington Drawn Cup Roller Bearings offer performance advantages in all types of generators and appliance motors. The cost is remarkably low . . . in many cases, armature bearing costs have been lowered by as much as 50%. For advice on the application of Torrington Drawn Cup Roller Bearings to your specific problems, call or write: **The Torrington Company, Torrington, Conn.– and South Bend 21, Ind.**

Armature-mounted Torrington Drawn Cup Roller Bearings offer these outstanding advantages:

- Highly efficient roller guidance
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SAE JOURNAL

For Sake of Argument

Telling Others . . . .

Do you usually aim at telling others what you think they want to know — or do you concentrate mostly on what you want them to know?

Sure, there's some of both in most communications — oral or written. But one or the other tends to predominate each time you write or talk. There would be little choice between them, if each got ideas from one mind just as surely as the other. . . . But that isn't the case.

Unless your reader decides you have something he wants to know, you have little chance to reach him. As a reader of your memorandum or report, he simply puts it aside. As a listener, he moves his mind, if not his body, somewhere else. In either case no communication takes place.

No matter what we say or write, the other fellow has to take action to receive it. He has to open the door of his mind. So, whatever our secret objective, it's wise to package our ideas so it's easy for the other fellow to pick them up.

Best question to ask ourselves is: "What is he most likely to want to know about the things I want him to know about?"

The answer usually boils down to: "Make it easy for him. He'll open the door more readily to a message than to a problem."

So:

- Give him a "message" at the very beginning. Say straight out the main idea or piece of information you want to leave with him.
- Then stick to the point. Amplify, prove, or develop that main idea.
- Then tell him at the end, in different words perhaps, the same thing you told him at the beginning.

Editorial-researcher Roy Eastman focused the writing problem of every engineer or executive when he advised recently that:

"An editor's job is partly to give his readers what they want; partly to make them want what they ought to get."

Norman G. Shidle

chips

from SAE meetings, members, and committees

RECOGNITION INCREASES RELIABILITY — Consider two cases of sealing in-wing fuel cells: In one case, a prevalence of leaks was ended in two months by giving recognition of the high degree of skill needed to achieve tight installations and putting the men who did this job in white uniforms. In the other case, the job title was changed from "'gunker" to a more dignified title and the men sealing the fuel bays were given white coats and a 5¢ per hr pay differential. This too put a stop to the problem of leaky fuel cavities.

RECENT IMPROVEMENTS in the iron powder, low-hydrogen type of electrodes have made it possible to deposit defect-free welds at increasingly rapid rates.

50 LB/SEC AIRFLOW looks to be the optimum size of jet engines. On either side of this figure the thrust specific weight increases. Larger engines lose out because weight goes up as the cube of diameter while airflow rises as the diameter squared. Below 50 lb/sec many parts have already reached their minimum practical dimension. Examples are blades and vanes.

DIESEL PENETRATION OF THE HIGHWAY VEHICLE and farm tractor markets has been increasing by leaps and bounds. For example, 1958 truck registration figures showed that in the over-26,000-lb gvw class 43% were diesel-powered, compared with 29% for 1956. Similarly, March 1959 farm tractor deliveries were 34% diesel, compared with 26% (or 69,700 units) in 1958.

FUTURE OF POLYMERIC MATERIALS in automotive vehicles looks particularly bright. Included in an impressive list of future applications are: adhesive materials in place of rivets and screws; wider use in assemblies and sandwich construction; replacement of lead body solder; wire coating materials; moldable sheets, pipes, and rods that may be used for fenders, doors, hoods, gas tanks, and fuel lines; and the use of hard, machinable polymers in servomechanisms with the advantage of light weight, quiet functioning, and self-lubrication.

We are rewarded not for what we do, but by what we do.

NO REAL CLUES to the stability of jet fuels are offered by bromine number, olefin, aromatic, or sulfur content, and gum value. The lack of correlation was established by comparing threshold stability temperatures obtained with CFR fuel coker tests with fuel inspection data. For example, potentially unstable fuels can be high or low in gum value.

Truth has no anniversaries.

TRUCKS DROVE 115 BILLION MILES during 1958, a 55.4% increase since 1948, according to the Automobile Manufacturers Association.

WORLD'S FIRST RUBBER RAILROAD CROSSING has been installed at Wooster, Ohio, between curved tracks. Reason: ice won't hold on the rubber pads and bumps for motorists are eliminated.

MAGNESIUM SUBJECTED TO INTENSE β-RAY BEAMS showed no measurable changes in mechanical properties, in tests run by Dow Chemical engineers. The only changes they were able to detect were in the electrical resistance, which is a measure of the disturbance of the crystal pattern. Such an effect would not have been expected, for example, if the magnesium had been a magnesium-lithium alloy, which has a cubic crystalline pattern that has the same electrical conductivity in all directions.

"A COMMITTEE is a group of people gathered together to keep one man from doing the job."

Marking Wayne Worthington's retirement from the Tractor Technical Committee, fellow committee member R. W. Hautzenroeder noted that Worthington has actively refuted this idea since first involving himself in SAE standardization work 42 years ago.

1960 Passenger-Car Engineering Trends

ECONOMY CARS lead trends in engines, bodies, and weight reduction. Materials, electrical equipment, and safety features also got a lot of attention this year.

Walter G. Patton
Engineering Editor, SAE Journal

(Written at the request of and with the cooperation of the SAE Passenger-Car Activity Committee and the SAE Body Activity Committee)

NEARLY lost in the headlines describing the new compact cars and the 1960 unitized bodies is a simple fact that may be even more important to automotive engineers and the industry's suppliers: This is the year in which it became evident that engineers will, henceforth, have a much more important role in designing and building American passenger cars.

Cut-and-try designing of automobile chassis and body components is running out in Detroit. Computer engineering and the scientific approach are coming up fast. Teamwork — involving styling, engineering, and manufacturing — will be the keynote in building future U. S. passenger cars.

Stylists will continue to play an important role in automobile design, to be sure. Nevertheless, evaluating the stylists' dreams on a scientific basis (as well as a cost basis) is rapidly becoming one of the top responsibilities of the automotive engineer.

The U. S. passenger-car industry has gone scientific! The truth of this observation is brightly reflected in its 1960 models:

- With the aid of computers, engineers are now "building" engines, suspensions, body and engine mounts, and other chassis components

on paper even before prototype parts are started. This is being done on a wide scale.

- The unitized bodies introduced by the Big Three for their smaller cars are the most intensively engineered bodies in the history of the industry.
- Chrysler's first unitized body is the most thoroughly engineer-evaluated design in the history of the company.
- Chevrolet's introduction of a rear-engine car climaxes a long and detailed engineering study of weight distribution, aircooled aluminum engines, and other features. Similar studies have been conducted by other car producers. (Results of several of these studies will be disclosed later in SAE Journal.)
- A dividend from the industry's current efforts to build into its automobiles practical, economical performance at normal driving speeds is typified by Chrysler's new ram induction. More engine developments directed at improving performance in the normal driving range are expected.
- The introduction of the first U. S. passenger cars in recent years in which weight targets held the spotlight. Design of the new, compact cars proceeded, step by step, with weight control always the primary target. This apparent change in industry viewpoint could be a tremendously important factor in the future of American passenger-car engineering.

During the past year there were developments of some significance in materials and electrical engineering, such as:

- The first aluminum engine (with cast-iron cylinders). Aluminum engines could become one of the most farreaching changes in the history of the American industry, although present opinion on this subject is far from unanimous.
- The growing use of duplex chromium and duplex nickel plating and improved test procedures. These promise better brightwork on tomorrow's passenger cars.
- Electroluminescent lighting, which made a reappearance. Many engineers are predicting significant changes in both interior and exterior lighting during the years ahead.
- Introduction of alternating electric current in U. S. passenger cars.

Many other trends, less self-evident, have emerged with the 1960 models and could be spotted by experienced Detroit engineers:

- The horsepower race is dead . . . temporarily, at least.
- The steep rise in the engine compression ratio curve has been halted . . . by the trend to 6-cyl and economy engines, rising fuel costs, and engine problems encountered at compression ratios higher than 10.5/1.
- The entire automobile industry is carrying on a war against corrosion and against squeaks and rattles and other annoyances in passenger cars. Unitized bodies will help, but many interesting chapters remain to be written.

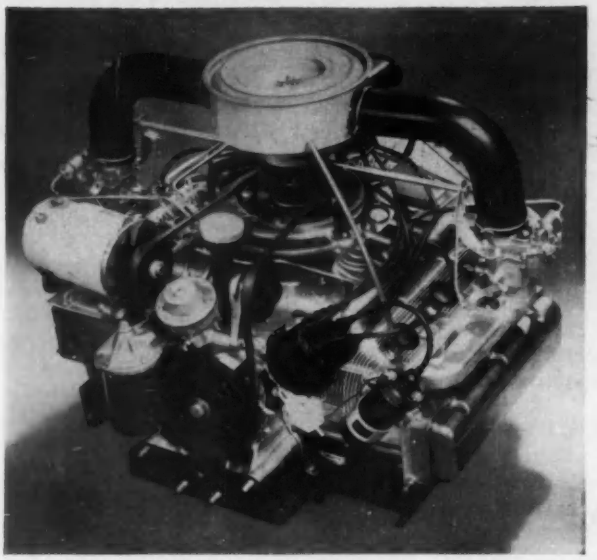
Safety continues to get the attention of the industry's engineers but many significant advances in this area will undoubtedly go unnoticed. Here are a few interesting items:

- Use of deep-dish steering wheels, recessed controls, safety-type visors, and padding of instrument panels is increasing.
- Trend to unitized construction will result in stronger, more rigid bodies; quieter ride.
- Brakes are larger, run cooler, and offer increased resistance to fade.
- Windshield wipers are more powerful and offer more positive washing action over larger areas.
- More lights and buzzers warn drivers against speeding, low oil pressure, and overheating.
- New, soft-ride tires promise greater life and increased safety.
- Exhaust systems are being designed and built for greater safety and to last longer.
- Antireflection-type instruments are featured on many cars.
- Automatic, power-operated door locks and theft-resisting ignition locks are now available on a number of cars.
- Chrysler is offering a 4-light flash system for motorists stopped for emergencies beside the highway.
- Seat belts are now standard equipment on Chevrolet's Corvette.

Contents of Article

Engines . . .

. . . emphasize lighter weight, improved performance at normal driving speeds, and reduced vibration. . . . Highlights for the year include Chevrolet's aircooled engine for the Corvair, Ford's new lightweight 6-cyl powerplant for the Falcon, and Chrysler's new 30-deg high-performance engine for the Valiant.



CHEVROLET OPPOSED 6-CYL ENGINE for Corvair is the first engine in the rear to be introduced by a large American manufacturer. Weight distribution is 40% in front 60% in rear.

A NUMBER of new passenger-car engines were introduced in the 1960 cars. There is Chevrolet's aircooled aluminum engine with cast-iron cylinders, mounted in the rear. And Ford has a new powerful, lightweight 6-cyl engine for the Falcon. (More data on these engines will be presented in later issues of SAE Journal.) From the standpoint of its possible effect on future engine design, introduction of a new water-cooled engine inclined at 30 deg from the vertical by Chrysler may also prove to be highly significant. Angular mounting permits a low hood. It keeps the center of gravity low. Of particular interest is the use of a die-cast aluminum manifold of unique design that permits improved fuel distribution to each of the cylinders.

It should also be observed that Chrysler engineers, as well as other producers, are making full use of light metals in their new

CORVAIR ENGINE IS AIRCOOLED and has no conventional cylinder block. Central structural member is an aluminum-alloy crankcase, which is cast into two halves. Three individual cast-iron cylinders are held in place by a cast-aluminum cylinder head.

engines. The new 225 cu in. Chrysler engine uses aluminum pistons, of course. Intake manifold, distributor housing, water pump housing, water outlet elbow, oil pump housing, and oil filter mounting pad are also made of aluminum.

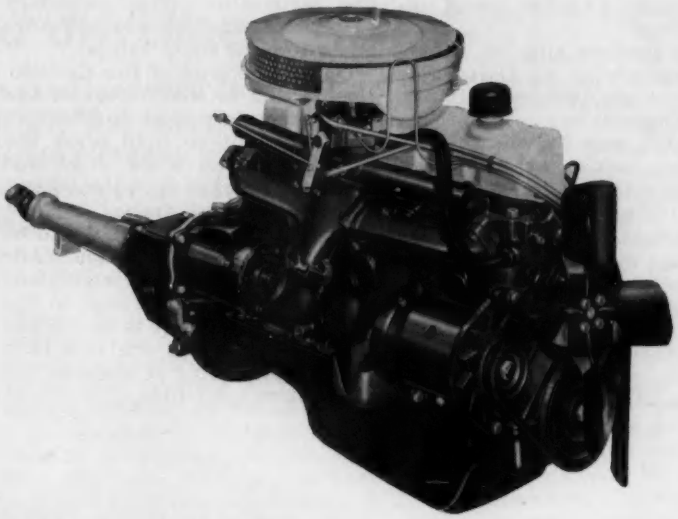
The trend toward lighter weight engines is evident in other models: the head for the Corvette fuel-injection engine is now aluminum, permitting a weight saving of 53 lb. New Buick engine parts include lightweight valve rocker arms, generator support bracket, and two generator end frames. This provides a total weight saving of 57 lb per engine through the use of aluminum.

Meanwhile, it is interesting to look at what has been happening to the recently strong inclination toward higher engine horsepower and increased engine compression ratios. In 1946, the average U. S. passenger car developed 100 hp. By 1957, the average had more than doubled, reaching 227. Since then, industry developments have knocked into a cocked hat all predictions that the industry average would rise to 280 by 1961. Increased demand for 6-cyl engines, increased customer preference for economy V-8's, and the impact of foreign cars and smaller domestic cars have rudely interrupted, it appears, the widely predicted upward trend in average horsepower.

Similarly, the sharp, seemingly endless upward climb in average compression ratio . . . from 6.7 in 1946 to 8.8 in 1957 to an anticipated 10.7 in 1961 . . . has been sidetracked.

The trend toward smaller engines has been accompanied, as would be expected, by improved fuel economy. Practically all car producers in the small, low-price and medium-price class are offering engines that operate on standard fuel. There have also been a number of minor but significant engine refinements contributing directly or indirectly to greater fuel economy. Here are some of these changes:

Chevrolet reports improved volumetric efficiency and improved fuel economy throughout the driving range. Olds' new economy engine has a compression ratio of 8.75/1. In addition to a new carburetor, Olds has a special cylinder head and pistons. A low-speed high-torque camshaft is used. With a 2.87 axle, fuel savings up to 15% are claimed.



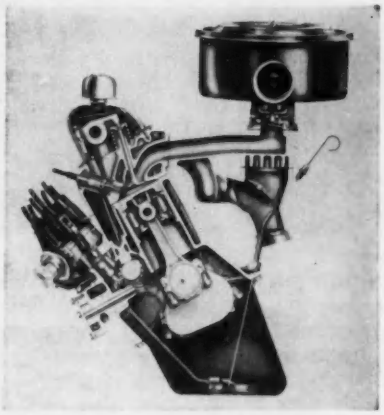
FORD FALCON ENGINE has 144 cu in. displacement, weighs only 345.5 lb. Advanced ideas in simplicity for manufacture, porting, combustion-chamber design, and manifolding have been built into it.

These are typical of steps currently being taken to improve fuel economy for the average car owner. There is also a noticeable tendency on the part of most car producers to offer reduced axle ratios in 1960.

Another outstanding trend is an almost across-the-board introduction of new engine mounts. Chrysler engineers say their new engine mounts represent the most significant improvement in the reduction of engine vibration since 1951. This improved mounting system puts the powerplant to work as a dynamic damper. Flexibility of the mountings causes the engine to vibrate out of phase with road-induced car shake, damping out shake noticeably. Chrysler engineers say they studied and evaluated more than 500 different designs before a decision about mouting design was reached.

Buick's new single, dynamically tuned shear-type rear engine mount replaces support and thrust mounts used previously. The new mount is soft vertically and laterally, but is stiff against fore-and-aft movement. New and improved engine mounts have also been introduced by Cadillac, Imperial, Edsel, and others.

Continuation of a long-standing trend toward improvement of the choke and the carburetor is noted again. Ford engineers, for example, have relocated the intake manifold to the right of the exhaust manifold to provide more reliable automatic choke operation. All Ford V-8 carburetors have new automatic chokes for improved cold-weather start, idling, and better economy. Another interesting engineering change in



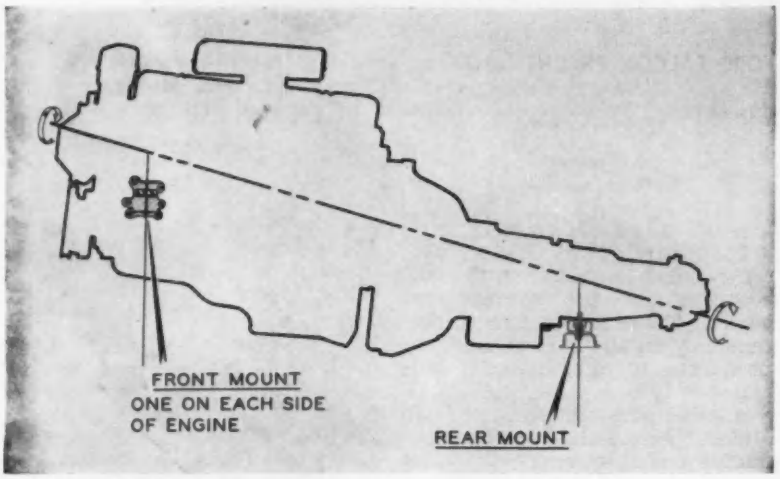
CHRYSLER VALIANT ENGINE INCLINES 30 DEG TO THE RIGHT from the driver's seat looking forward. Water pump is mounted off to one side. Intake manifold is an aluminum die casting consisting of six long tubes, which supply fuel and air individually to each cylinder.

Ford carburetors is the use of nylon bearings.

A new positive stop on the 4-barrel carburetor of Oldsmobile also provides improved idling. This mechanism was devised to insure a solid base for the throttle linkage to return against when the driver's foot is removed from the accelerator pedal. Very light pedal loads at closed throttle made the change necessary.

The previous mechanism had been used to guarantee against holding open the secondary throttle valves. This requirement has been eliminated by better precision in the manufacture of the carburetor. The secondary throttle return spring is now adequate to close these valves.

On slow closing of the throttle, the friction in the linkage of the Olds secondary-stop mechanism was sufficient to hold open the throttle linkage when there was still clearance between the several links, levers, and shafts. On fast closing all the clearance would be taken up. This difference made it impossible to get a consistent idle speed. With the stop on the primary valves there is no mechanism involved and the new Olds carburetor simply returns to the same place each time.



BUICK ENGINE IS SMOOTHER, thanks to a change in the basic tuned 3-point powerplant mounting system. A new shear-type transmission mount replaces the support and thrust mounts used previously.

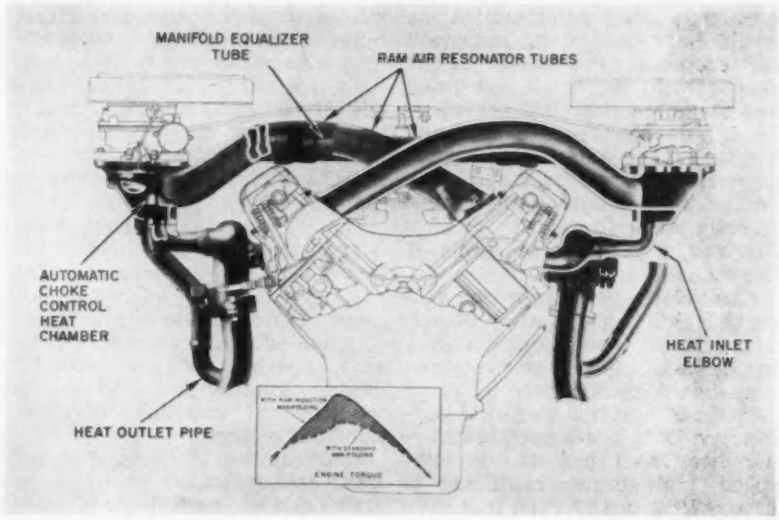
There are other significant engine changes for 1960. Here are some of them:

Chrysler Corp.'s new ram induction forces air and fuel into the engine when the throttle is opened. No power is taken from the engine and there are no moving parts. Torque increases up to 10% are available in the 1800–3600-rpm range. This additional torque is provided at normal passing speeds and may be used to avoid kicking down the transmission into a lower range.

Ram induction uses mass inertia and sonic resonance effects to provide its "free supercharging." The column of fuel and air in the ram manifold continues to move as the intake valve closes. Ramming continues up to the last moment. Meanwhile, each long branch of the manifold acts like an organ pipe in which a compression wave travels back and forth at the speed of sound. By adjusting the length of the branch so that, at certain engine speeds, the compression wave is at the valve when it is opened, additional compressed gas-air mixture is forced into the cylinder.

Chevrolet's 283 cu in. engine has an oil drainage trough cast along the outer edge of each cylinder head. Oil is prevented from accumulating in the valve spring seat pockets by an opening to the trough.

New polyurethane air cleaner elements introduced this year can be cleaned repeatedly. Replacement is not necessary, as in the case of a paper element.



CHRYSLER RAM INDUCTION is reported to give up to 10% torque increase in the 1800-3600-rpm range. No power is taken from engine.

Transmissions and drivelines . . .

. . . lighter, smaller transmissions and improved drivelines are outstanding engineering trends. . . . But important changes are also being made in transmission clutches, valving, filtering, and shift patterns. . . . Introduction of transmission in the rear by Chevrolet Corvair will be closely watched by the entire industry.

MANY Detroit engineers feel the new smaller, lighter transmissions in front introduced this year represent an interlude ahead of the adoption of transmissions mounted in the rear of the car. This style may be taken by other important segments of the industry. The performance and public reaction to the Corvair rear-mounted transmission is certain to be one of the engineering highlights of 1960.

Meanwhile, here are the significant changes in transmission-in-front design reported this year: By reducing the diameter of the converter housing and changing the location of the controls, important space savings have been made in several automatic units. Chrysler's new 3-speed unit has been reduced in weight so that, installed, it is only a few pounds heavier than a manual transmission. A one-piece aluminum converter and housing is specified. General Motors' Hydra-Matic has been extensively redesigned to provide a slimmer contour. In most GM cars, the hump is 2 in. narrower than last year. Changes in floor height range from about 0.3 to more than 1.0 in. lower. A new micron screen filter on several cars provides improved oil filtration.

Ford's 2-speed Fordomatic has been recalibrated to give an improved, smoother shift pattern. Converter stall speed has been changed to provide better initial startup and improved high-altitude performance. Diameter of the converter has been reduced from 12 5/16 to 12.0 in. Maximum torque has been increased from 1.9/1 to 2.1/1.

New features of the Ford 2-speed transmission include valve body changes; revised springs in the main control assembly; revised lower valve body and pressure regulator valve body and spring. Upshift is softer and passing performance is improved.

Buick's new sungear overrunning clutch has a new sprag clutch. Changing the stator blade high angle permits slower engine speed at full throttle.

The deflection characteristics of the Studebaker-Packard ringgear have been developed to improve the gear tooth contact and reduce axle noise. The new unit is produced by Dana Corp. With its improved deflection characteristics, a 7⅛-in. diameter ringgear can be used in place of the previous 7¾ in. diameter ringgear without any reduction in load carrying capacity. The smaller gearset results in an axle assembly that is 4 lb lighter than that previously used.

The new Studebaker-Packard axle also provides for lower numerical gear ratios for increased economy with the V-8 and automatic transmissions. The Twin-Traction differential is incorporated in the new axle design.

Chassis and suspension . . .

. . . problems are yielding to design changes made in the 1960 cars. . . . New nylon-skirted shock absorbers, better shock absorber fluids, and improved bushings are in the spotlight this year.

EFFORTS by automobile engineers to provide a softer, more comfortable ride that is relatively free from vibration and harshness are continuing. Engineers working on the problem of improved front suspension may follow several different approaches: softer springs, redesigned ball joints, improved shock absorbers. Each of these methods has been used. In addition, one producer has used the approach employed a year ago by Pontiac — adopting a wider tread for improved stability.

The most significant change in shock absorbers is an across-the-board adoption by General Motors of a nylon-skirted piston for its shock absorbers. Nylon replaces metal for this application.

The nylon skirt provides an excellent bearing material; scuffing of the cylinder walls is also reduced. In addition to the nylon skirt, General Motors cars are using a new shock absorber fluid having a more constant viscosity and, therefore, less susceptibility to temperature variations.

Cadillac has reduced its coil spring rate 10%. Buick's new front suspension ball joint employs a coil steel preload spring, replacing a rubber spring.

Pontiac is using a new, larger bushing on the lower control arms to provide a softer ride and resist road shock. The upper control arm axle attachment has been raised.

Ford and Edsel front tread has been increased from 59 in. to 61 in.; rear tread from 56.4 in. to 60 in. The Ford-built frame is 11.8 in. longer overall.

Edsel's ball joint front suspension has been redesigned for the new 61-in. tread. Body mounts are improved. Rear springs are 60 in. long — a 2 in. increase compared to 1959.

Some steps being taken to eliminate noise and vibration at the source are further indicated by the Mercury front suspension. Here the lower arm is swept back 20 deg to reduce transmission of road harshness. A larger rubber bushing is used in the front suspension lower arm shaft, where it

is attached to the frame. There is a new Teflon, antithrust bearing between the two metal surfaces of the ball stud and ball bearing surfaces of the ball joints.

Harsh impacts are further cushioned in the Mercury by butyl rubber compression bumpers. Mercury's triple-action shock absorbers have small orifices in the valves that permit low-velocity flow of fluid under good road conditions. Blowoff valves open larger fluid passages under moderately rough road conditions. "Dual restrictions" will allow fluid passages under poor road conditions. In addition, a new all-weather shock absorber fluid is used.

There have also been some interesting changes in rear suspensions to gain stability, reduce shock, and improve riding comfort.

Rear suspension of Chrysler cars features these improvements: There are larger diameter rubber bushings in rear spring eyes; spring eye location is tailored to car handling needs; wide span rear spring shackles are used on suburban models; low-velocity-control Oriflow shock absorbers are specified; constant-section main spring leaves are employed.

A Corvette stabilizer bar, added immediately to the rear of the rear axle, increases stability and makes unnecessary the use of heavy-duty springs and shock absorbers.

A new Hotchkiss rear suspension is a feature of the Lincoln. This suspension has symmetrically mounted, longitudinal leaf springs, 2½ in. wide. There are eight leaves in each spring. Both upper and lower shock absorber mountings are moved outboard.

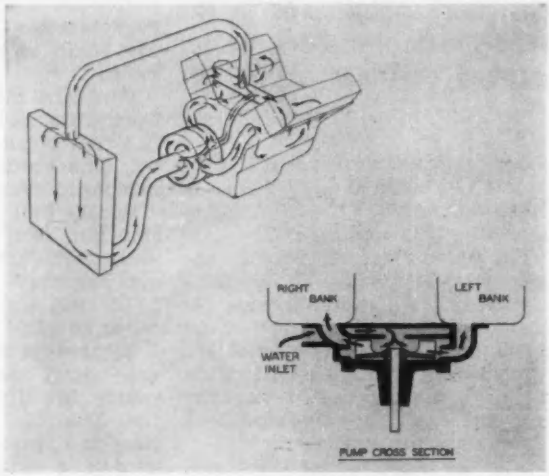
On the Ford, resistance to rear sway and axle windup has been improved as a result of outboard mounting of the rear spring and mounting the axle well forward of the spring center. The long, flexible rear section provides a softer ride. New springs are said to minimize rear end squat on acceleration and dive on braking.

Cooling systems . . .

. . . must have stepped up capacities in spite of lower hoods. . . . Ford and Chevrolet Corvette have cross-flow radiators. Pontiac's Equa-Flow system features a 2-chamber water pump. . . . Fluid drive fan is introduced.

LOWERING of the car hood has created a number of problems for the automotive engineer, not the least of which is cooling. The new Pontiac Equa-flow cooling system and cross-flow radiators introduced by Ford and Chevrolet are in response to the need for more efficient engine cooling under restricted conditions. Despite obvious gains being made, many engineers believe there is a need to provide even more engine cooling under critical driving conditions. The engine cooling problem is certain to get a lot of attention during the next few years.

An outstanding engineering development in the Pontiac is a new cooling system designed to distribute water uniformly and in equal quantities to both sides of the engine. The Pontiac setup provides a dual-chambered water pump. Coolant is sent directly from the double-chamber pump to each side of the engine block, then up to the cylinder head and out the intake manifold water crossover for recirculation.



PONTIAC DUAL-CHAMBER WATER PUMP is designed to distribute water uniformly and in equal quantities to both sides of engine.

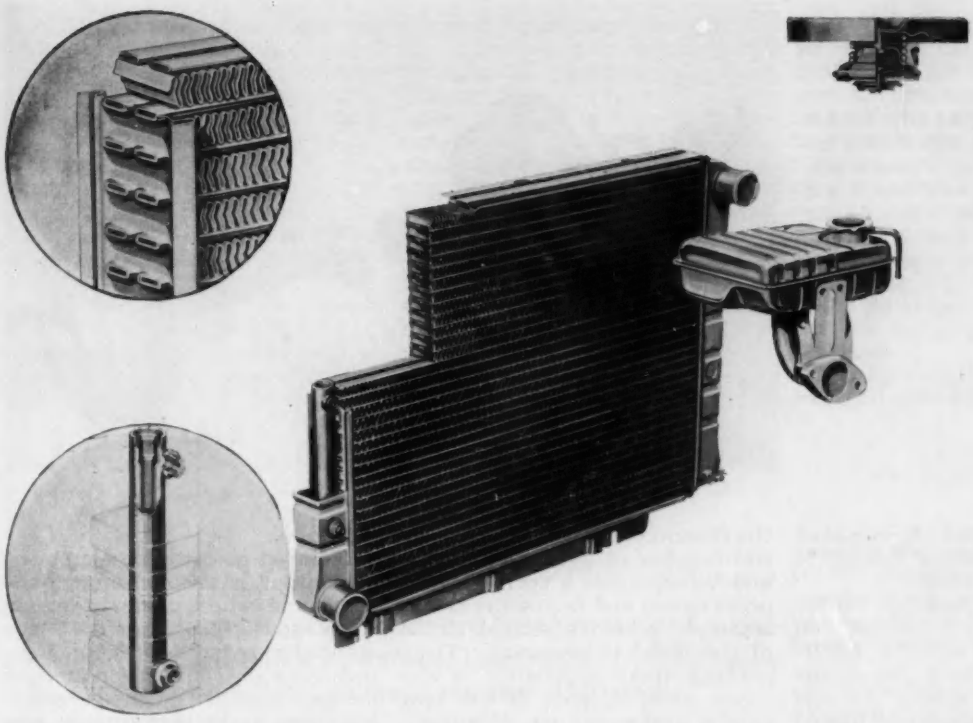
Advantages claimed for this system are: (1) equalized distribution to avoid engine hot spots, (2) fewer parts in the system, (3) weight reduction, and (4) easier to service.

A new radiator designed by Ford engineers is a pressurized cross-flow type with a separate supply tank designed to fit under a low hood. Improved cooling at idle, improved airflow efficiency with a low, wide grille, and better coverage of the radiator core are claimed for the new design.

Corvette is introducing an all-aluminum cross-flow radiator for use in high-performance engines. A temperature-modulated fan drive is also being offered. Maximum fan speed is 3100 rpm. The Corvette fan has been moved 1 15/16 in. closer to the radiator.

On Chevrolet, a temperature-regulated fan-drive makes possible the use of a high-capacity fan blade assembly that moves enough air at low speeds for both engine cooling and air conditioner condenser cooling.

The Buick radiator and fan have been moved further forward ahead of the engine. This provides improved engine cooling and minimizes noise; it also eliminates the necessity for a shroud.



CROSS-FLOW RADIATORS came back into the picture in the 1960 model cars. Shown here is the Ford radiator assembly with a separate tank.

Brakes . . .

. . . are changing rapidly in design. . . . Larger drums and more lining contact are the trends. . . . Cooling capacity is increasing and the use of aluminum is growing. . . . Pontiac is offering as optional equipment an aluminum wheel-and-drum designed to dissipate heat rapidly.

IT has been estimated that stopping a modern automobile from cruising speed generates enough heat to melt 3 lb of cast iron. Today's braking problem is essentially a heat problem. That is why improved braking systems for this year's cars follow a number of different patterns — but most steps being taken are designed to deal with the heat problem.

Most cars offer improved designs usually with larger drums and increased lining contact area. A number of different steps are being taken to provide additional cooling. Where aluminum is specified, weight is reduced and heat conductivity is improved.

Another approach to the problem is to revamp the entire braking system — from the brake pedal to the drum — and including the parking brake. Examples of each of these approaches will be found in the new passenger cars. Here are some brake design changes in the new cars:

Chrysler Total-Contact brakes now have three stamped-in platforms for each shoe. These bear against three corresponding projections. This provides more accurate alignment and eliminates brake noise. Brake support plates are spaced farther apart.

Brake lining area has been increased for Edsel station wagon models. Premium compound riveted linings are supplied where fade characteristics are important.

Ford brakes have been increased in size, both front and rear. To achieve better balance between front and rear wheels, larger bore wheel cylinders are specified for the front wheels. Drums are a composite type, having a steel disc fused to a cast-iron drum. The rim is grooved to give improved cooling characteristics.

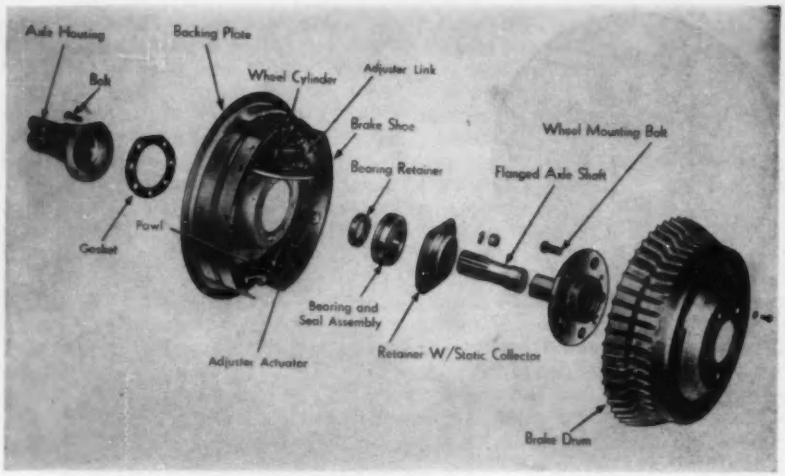
Rambler has replaced riveted linings with bonded linings.

Lincoln has new, thicker brake linings. Usable lining thickness has been increased from ⅛ in. to 3/16 in.

Here are typical steps being taken to provide more cooling:

Imperial wheel covers are again slotted around the periphery for improved drum cooling. Openings in the Buick wheel and wheel cover provide increased brake cooling. Area of the Buick wheel openings is 8 sq in. per wheel. The wheel covers have 12 holes for ventilation. Cadillac is using finned cast-iron rear brake drums this year. Brakes on the Cadillacs are self-adjusting.

Buick is continuing aluminum front brakes and finned, cast-iron



INCREASED REAR BRAKE COOLING on Cadillac cars is made possible by new finned and extended rear brake drums. Rear brake cylinders are larger so front braking load can be reduced. Brakes are self-adjusting.

rear drums. Drums are balanced dynamically by adding weights to *both* sides of the drum.

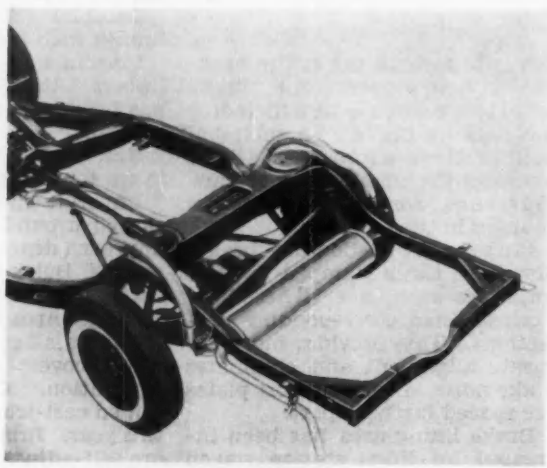
Ratchet-type parking brakes have been widely introduced on the 1960 cars. In addition, Cadillac's new parking brake has an automatic vacuum release for use when the gear selector is moved into forward or reverse driving gear. This is the first automatic release offered by the industry.

A new parking brake system on the Chevrolet Corvette retains the convenience of pedal application and incorporates a spring-loaded pedal return and ratcheting mechanism to permit a second stroke of the pedal if necessary. Thus, parking brake application is virtually assured, even if the rear service brakes are out of adjustment. Reliability of the service brake has been increased by adding shields at all four wheels. Corvair has a ratchet-type parking brake.

Included as optional equipment by Pontiac is an aluminum hub-drum and wheel center designed to dissipate heat rapidly. Substantially reduced braking temperatures are claimed for the new design, together with generally improved brake performance and outstanding resistance to brake fade. The aluminum hub-and-drum construction also saves an appreciable amount of weight.

Fuel and exhaust systems . . .

. . . the trend to simplified, aluminized and zinc-protected mufflers is gaining momentum. . . . Buick mufflers are being placed crosswise. . . . Some interesting changes are being made in fuel tanks.



BUICK SINGLE-UNIT MUFFLER employs a blending action. Unit is placed transversely in car.

MUCH of the industry's research efforts on mufflers has been directed toward elimination of cold areas, where corrosion is known to occur at accelerated rates. As a result of selective protection, many automobile engineers feel a substantial contribution has been made toward extending muffler life.

The Buick exhaust system has been completely redesigned. A single muffler, placed crosswise in the rear of the car, replaces four mufflers used in 1959 with dual exhaust.

The new muffler has an inlet pipe and an outlet on each end. Gases from each bank of cylinders, after passing through individual resonating chambers, are blended in a common chamber.

Blending is reported to make the silencing action much more complete. Use of a single muffler, eliminates the cold-side muffler in a dual system. Exhaust gas flow resistance has been reduced by increasing the diameter of the exhaust pipe ¼ in. All steel parts are coated with zinc or aluminum.

Ford also has a new aluminized cylindrical muffler. Double-walled inlet pipes are specified. Inlet pipe extensions are heavy gage. Muffler is of the free-flow type to minimize power loss.

Dodge mufflers are now located farther to the rear. Aluminized components are used on all models. A new ball-joint exhaust pipe connection simplifies muffler alignment.

New tail pipes on Chevrolet, ending about 10 in. behind the rear wheels, are directed outward. This avoids staining the rear bumper or damaging the tail pipe when backing into a snow bank or some other obstruction. Both the inner wrap and the outer wrap of the muffler are zinc-coated. Heads of the new mufflers are aluminum-coated. The outlet tube and nipple are zinc-coated.

Plymouth exhaust systems have been rerouted through the propeller shaft tunnel. This gives protection against road damage and permits dropping the floor pan. Aluminized components are now used on all Plymouth models.

Plymouth's new center-fill gas tank is farther to the rear. A new vent tube is designed to eliminate fuel loss during cornering, accelerating, and braking.

A woven plastic filter is placed in the Buick gas tank to catch dirt particles and keep water out of the fuel line.

Gas tank in the new Valiant is located in the left rear fender.

Electrical systems, instruments . . .

. . . and miscellaneous accessories are being revamped. Use of printed circuits and wire harness is increasing. 1960 sees introduction of electroluminescence and alternators.

IMPROVED voltage regulators, fool-proof terminals, and greater use of printed circuits were top electrical developments in the automobile industry this year.

General Motors' new voltage regulator permits less variation in system voltage with changing temperatures, reducing excessively high voltage during cold weather.

Ford-engineered cars now feature blade-type terminals for both the ignition switch and headlight switch. Nylon wiring clips and multiple gang connectors are used in various electrical circuits. Blade-type terminals on the inside of the switch assembly resist "bridging" by car thieves. An alloy wire from the ignition switch to the ignition coil now provides improved electricity flow at low temperatures. Heater wiring for 1960 is a part of the wiring harness.

Mercury has two printed circuits for instrument clusters. A fuse has been added in the generator charging circuit to prevent burning out the generator in case of voltage regulator failure.

Printed circuits are now being used by Lincoln in the instrument cluster controls. Multiple connectors permit easy servicing and assure trouble-free operation.

To provide improved heater performance and add to available electrical capacity, Pontiac is offering a 35-amp generator instead of a 30-amp unit. For cars equipped with air conditioning, the voltage regulator has an external fuse at the battery connector.

Guide Lamp's new automatic headlamp control is much smaller than the previous Autronic Eye, and it is adaptable to more body styles.

Electroluminescence, introduced this year by Chrysler Corp., provides attractive area lighting that is shadowless and free from glare. Windshield reflections are minimized.

Electroluminescence is produced by exciting a phosphor compound in an electromagnetic field. Light is produced by passing a-c current through two conducting surfaces, between which is a layer of sandwiched phosphorescent material. This material glows when it is excited by the current.

The typical Imperial instrument has five layers. A-c current is supplied from the 12-v d-c system, using a transistorized power supply developing 200 v at 250 cps. A control knob regulates the intensity of illumination.

On the Chrysler Division instrument panels, for example, the speedometer numbers, gage indexes, and pointers are now illuminated with a soft green glow. On the Imperial, the speedometer, engine gages, pushbuttons, clock hands, and control knobs are lit by electroluminescent lighting.

The use of an a-c generator equipped with a rectifying system, has been announced for the Chrysler Valiant. (Full details will be given in a later issue of SAE Journal.)

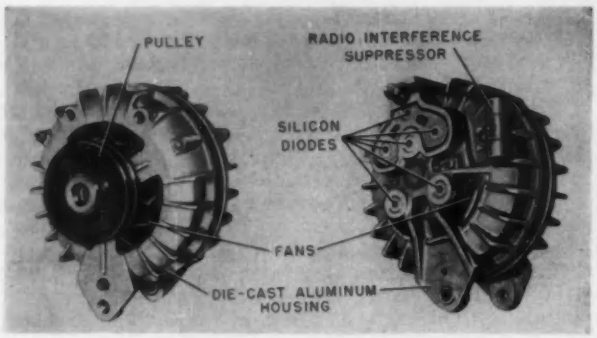
Reflection problems on instrument panels have been minimized for 1960. Buick, for example, uses an adjustable mirror. The 12½-in. Buick bar-type speedometer and the gasoline gage are located at the top of the mirror. Other indicators are located below the speedometer.

Chevrolet's gasoline and temperature gages have an indicating hand that is counterbalanced in the neutral position. Movement of the hand is damped. Weight no longer exerts a force tending to move the hand to the bottom end of the scale. Accuracy, particularly in the half-full to full range of the gasoline gage, is improved.

Dodge has a "see-through" speedometer, featuring black indexes on a frosted-glass background. An individually cowled speedometer is located behind the transparent section of the speedometer face.

Included in the changes made in the Oldsmobile are a new instrument cluster and a resistor-type fuel gage that provides greatly improved accuracy.

Pontiac is providing new clusters, improved gages and controls. Warning lights are provided for oil and generator indicators. A



INTRODUCTION OF ALTERNATOR on Chrysler Valiant provides improved electrical system. Alternator generates more current at low engine speed than does conventional d-c- generator.

warning light on the water indicator is optional. Also optional are warning lights for the speedometer and a fuel indicator light that shows red when the tank is down to ⅛ full.

The problem of keeping bigger windshields (with larger curves) clear and clean has been an engineers' headache for years. This year, several significant forward steps have been announced — by Olds, Chrysler, and Mercury, for example. Introduction of a novel new clock by Chrysler reflects continuing interest in what has become the auto industry's most criticized accessory.

Here's how Olds new super washer works: A cam on the washer pump has four lobes rather than two.

1. The additional two lobes cut the operation time in half, with 13–15 full pressure squirts per wash cycle.

2. The additional lobes also increase the nozzle pressure of the squirts from 9 psi to 12 psi. This gives better cleaning action when wipers are at low speed.

3. Cleaning efficiency is increased but less water is required and less time is needed for the cleaning operation.

4. With the addition of the 4-lobe cam, water will be squirted on the shield faster. As soon as the washer button is depressed, water will squirt onto the shield before the windshield wiper blades passes the point where the water hits the shield. When passing a car or truck and the windshield is covered with water and mud, washers will aid in quickly removing the blinding condition on the windshield.

With Chrysler's new windshield washer, a single push of a button both washes and wipes the windshield.

New Mercury windshield washer pump driven by the generator belt gives more positive washing action. There are two washer jets on each blade.

The new Dodge clock is housed in a plastic turret. Hour and minute indicators are circular, numbered dials which revolve past a stationary pointer. The "second" indicator is a red dot which "orbits" inside the turrent, providing a novel effect. On Imperial and Chrysler models, the dial face is lighted by electroluminescence.

Heating and air conditioning . . .

. . . equipment has been improved by many of the car manufacturers. . . . Better air distribution and simplified controls lead engineering advancements.

ENGINEERS' efforts to improve air distribution in heated and air conditioned cars are getting results. The introduction of temperature-controlled fans conserves engine horsepower to run an air conditioning system. These are some of the trends revealed. Here are some specific examples:

A new air distribution system has been designed for the Buick. Five cold air outlets are provided; the center outlet has a rotating valve. A ventilation outlet has been added at the right side on air conditioned cars. New baffling has been added to the Buick heater assembly. Floor duct from the main heater to the rear of the car has been increased to provide 50% more airflow, permitting the rear floor to warm up slightly ahead of the front floor.

Cadillac is introducing a temperature-controlled fan on all air conditioned cars. A fluid clutch mechanism is used to control fan operation. A bimetal strip provides thermostatic control.

Chrysler's new heaters have three defroster slots on each side. These openings direct a blast of heated air against the windshield. Rear window defrosters now have a 2-speed blower control. High-speed operation clears the window; low-speed operation keeps the window clear without excessive noise or draft.

In the Chrysler air conditioner system, freezing of the evaporator coil is prevented by throttling the flow of refrigerant through a new regulator valve.

Steering gears . . .

. . . have a number of engineering refinements, but not many major changes. . . . Chrysler introduces nonround steering wheel. . . . Mercury has a flexible joint in the steering column.

BETTER seals, faster-acting spool valves, new flexible joints, and improved needle bearings were included in the engineering changes announced in connection with steering systems.

A new dust seal protects the Buick power steering gear against dirt infiltration. An O-ring seal has been added under the Teflon piston-ring seal to prevent oil leaking past the piston ring.

There is a new sleeve bearing bushing on the Cadillac pitman arm shaft. This minimizes wear and assures longer peak power steering assistance without adjustment.

The Chevrolet power steering pump, formerly driven by an extension of the generator armature shaft, is now driven by a new crankshaft pulley.

Refinements on Chrysler power steering include new piston seals, a faster-acting spool valve, and the use of spring-loaded valve guides.

Both upper and lower rims (of the standard Chrysler Corp. steering wheel) have been reduced in arc to provide more visibility and more seat clearance.

A flexible joint in the steering column helps absorb road shock in Mercury and Buick cars.

Plymouth's new manual steering unit has needle bearings on the crossshaft, replacing bronze bushings. Ratio is 20.4/1; compared to 18.2/1 previously used. Steering effort is reduced up to 25%.

The Pontiac pitman mainshaft bearing has new and larger needle bearings. The upper thrust bearing has been redesigned. The pump ring is now steel instead of cast iron.

Tires . . .

. . . more synthetic rubbers are coming. . . . Tire squeal is on the way out. . . . Introduction of soft-ride tires and better production controls top 1960 developments.

MORE reliable knowledge of the fundamentals of tire construction, improved processing, and better control of raw materials promise a substantial improvement in tire life and better resistance to heat. Rayon and nylon are destined to compete energetically in the tire market for some time to come, with each side claiming superiority. Use of synthetic rubbers having the same properties as natural rubber is increasing.

These are the basic trends in passenger-car tires. However, several recent developments in the tire industry deserve special attention.

An outstanding recent tire development has been the introduction of a new soft-ride or quiet-ride tread by all major rubber companies. The new quiet ride tread stock gives the customer a softer ride, especially on roads where cracks and other imperfections normally produce vibrations in the car. Vibrations, it is claimed, are ironed out by the extreme softness of the new tread. The quiet-ride tread, it is reported, also greatly reduces corner or brake squeal.

The quiet-ride tread has been made possible by advances in polymer chemistry. Synthetic rubber can now be manufactured with larger molecules than heretofore to give extraordinary toughness to rubber. Normally, molecules of this size would yield a tread stock with harsh riding characteristics. This has been overcome by special modifiers having extremely small molecules. The result is a tread stock much softer than any previously used commercially but that retains the toughness and wear properties car owners want. Longer life and a higher coefficient of friction are also characteristic of the new tires.

An equally important development is the recent announcement of greatly improved instrumentation and precision control of tire manufacturing processes and raw material by Goodyear. Using beta rays from strontium 90 and other radioactive byproducts, the heaviness and thickness of rubber fabric sheeting can now be closely controlled, it has been announced by Goodyear scientists. X-ray and fluoroscopic machines spot check internal tire construction. Electronic checks of such qualities as out-of-roundness are now being made at Akron.

Many automotive engineers feel the recent Goodyear development marks an important engineering breakthrough in an area that has heretofore defied precision control.

Captive-air tires are now standard on Rambler 3-seat station wagons and optional on all other Ramblers except American.

continued on next page

Bodies . . .

. . . are being designed more scientifically as unitized bodies receive increased attention — and adoption — and car heights continue to drop. . . . New methods of rustproofing are being followed.

BODY engineers agree: since 1950 the number of engineering man-hours going into body design has more than doubled. Increased use of power equipment (window lifts, power seats, air conditioning, and the like) has been a factor. But curved windshields, curved windows, and other design features have contributed, too.

Weight saving has emerged this year as the No. 1 objective in body design. In designing the compact cars, for example, the weight target was the most important consideration after providing adequate seating space for passengers.

Getting more work out of each pound of material is indeed a primary target of the body engineer. And computers are playing a big part in reaching this objective, permitting evaluation of many designs that could not be evaluated previously with available manpower.

In the postwar era (1946) styling moved boldly out front . . . and stayed there. Until a few years ago, styling tended to work alone. Today, advanced styling and advanced engineering are working more closely together. New models have to be sound from an engineering standpoint *before* they are judged on their ability to please customers.

Unitized bodies are saving weight . . . but probably not as much as might be expected. Up to 125 lb per car is a good guesstimate. All-welded construction makes for stiffer, more rattleproof bodies. But new problems have been introduced.

Dip treatments — to apply cleaning and bonderite prior to spray painting — are making an important contribution here. Two important engineering steps must be taken: (1) to introduce adequate drain holes to release liquid accumulating during dipping and (2) to insert rubber plugs to seal off certain areas in the body after draining.

Body joints are being designed for better, more effective sealing. There has been a noticeable improvement in the design of weather strips and antisqueak materials.

Glass, as might be expected, is a major problem for the body engineer. If the glass is not under load, it contributes only limited strength to the body structure. If loading is too heavy, harmful stresses may be set up. An experienced body engineer puts it this way, "Glass mounts must be rigid and flexible at the same time."

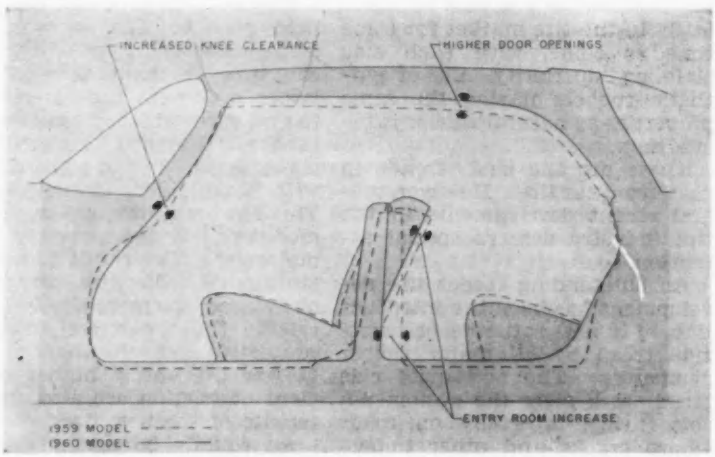
Engineering effort on passenger-car ornamentation is also increasing. Pleasing design is only the first step; "easy-to-make" is at least as important.

Extruded (as well as die cast and stamped) aluminum has replaced zinc for many auto grille applications. Improvement in bright dip processing has been a contributing factor. Better control of anodizing quality is another advantage. Stainless steel is also used extensively.

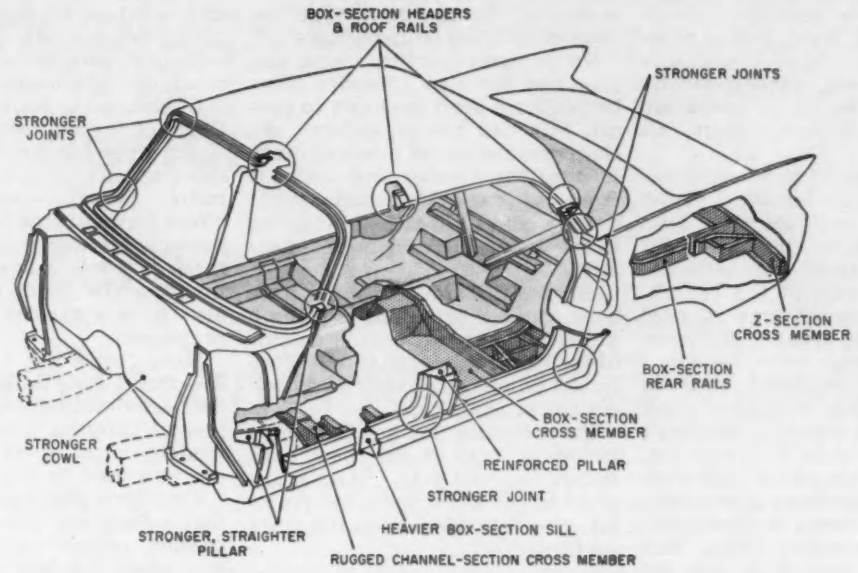
The new small cars have been "engineered" all the way. Starting with the passenger compartment, work and development has been pushed, always with weight saving a primary objective. This is the policy today throughout the auto industry. Increased importance of the stress engineer and increased confidence in his findings are significant trends in automobile body engineering today.

Design of Chrysler's new unitized bodies was facilitated by and very much dependent on the early engineering development work. Extensive laboratory and field tests were also conducted before designs were accepted by management.

In the new Chrysler bodies, metal gages have been increased in many critical underbody areas. Supporting the engine and front suspension is a new front substructure. This is bolted to the body at 10 locations.



CHRYSLER UNIBODY PROVIDES IMPROVED ENTRANCE AND EXIT. Disappearance of "dogleg" and general improvement in accessibility are shown in this comparison of 1959 and 1960 4-door hardtop models.



CHRYSLER UNIT-BODY CONSTRUCTION has a front substructure (bolted to body at 10 reinforced locations), which supports the engine and front suspension.

Other significant features of the Chrysler bodies are heavier underbody sills, increased sill inner panel thickness, and more rigid lateral bracing. (Full details will be presented in a later issue of SAE Journal.)

Chrysler's front door hinge pillars (and Ford's) are almost straight, eliminating the "dogleg" and facilitating entry and exit. Since bolted construction is used, front fenders and the grille can be readily removed for repair.

The Chrysler front seat has been moved 1 in. forward. Rear floor is lower and has built-in foot rests.

Static structural tests of Chrysler's unitized bodies show 100% increase in torsional rigidity of a 4-door sedan and 40% gain in beam strength. Bodies are roomier, seat heights are raised, both front and rear.

Typical of the new Ford bodies is the Edsel, which has a body 5½ in. longer than 1959 models. Front wheel tread has been increased 2 in., to 61 in. Overall width has been increased 1.7 in.

Edsel front entrance room at the beltline has been increased 10 in. Windshield area is increased 17%. A 4-door sedan has 36% more glass area. Posture angle has been set at 23 deg for maximum comfort. Vertical distance from the seat cushion to the top of the door opening has been increased 1.1 in. Shoulder room is increased 3.3 in. in the front seat and 4.4 in. in the back seat.

Ford wide hood design gives more rigidity to the fenders and makes the engine compartment more accessible.

Ford bodies for 1960 are lower than were the 1959 models and have more interior space. Ford's minimum heel-to-deflected "A" point standard is set at 4.4 in. Angle of vision through the windshield is increased 55% and rear vision has been improved 69%. Windshield sweep area has been increased 33% over 1959. Length of the wiper blade is up from 13 in. to 15 in.

The Imperial body is attached to the frame by 22 alloy-steel bolts, thus, in effect, unitizing the construction. Body changes include stronger roof construction, reinforced front door hinge pillar, stronger rear door lock pillar, and new fuel tank filler location.

Body of the Olds 88 and Super 88 is 0.8 in. shorter than the 1959 model. Overall length of the Olds 98 is reduced 2.1 in.

The Rambler 3-seat station wagon has a leftside-hinged rear door in place of the tailgate. This is the first of its kind in an American-built car. Necessity for climbing over the extended tailgate is eliminated and the rear window can be raised and lowered from the inside.

Insulation of Chrysler bodies has been improved by means of new keyhole grommets in the dash liner, new insulating materials in the floor pan and cowl side panels, and more effective use of roof silencers. Sound deadener applications have been increased. Asphalt-impregnated felt pads, laminated fiberglass silencers, and similar materials are used liberally.

Chrysler-built floor pans, for example, are coated with 36 lb of fluid deadeners. This is covered with a felt and mastic pad. A jute silencer pad, ¾ in. thick, overlays this. The jute pad is then covered with rubber or cloth carpeting.

On Dodge models, the weight of the wheelhouses is increased as much as 60% by the use of sprayed fluid deadener.

Ford body mounts have been relocated to give improved cushioning from road shock. Body shake

has been reduced substantially.

In the front roof bow reinforcement, Ford now uses ½-in. fiberglass material; behind this reinforcement, a ¼-in. satinaire insulation is used. Fiberglass 1 in. thick and ⅛ in. finish board are used as a dash insulator on all models.

A ¼-in. layer of wood composition material is installed under the Mercury package tray trim panel to isolate the passenger compartment from noise emanating from the rear of the vehicle. A layer of polyethylene is used under the radio speaker grilles on the package tray.

New sound insulation material and new testing techniques have been used to develop Mercury's 1960 "sound-shield" program. Many sound-absorbing materials are used, including glass fiber, spray-on deadener, and asphalt-impregnated waffle felt. New butyl rubber insulators and the use of 18 body mounts help to isolate noise and permit flexible tuning adjustments.

Olds passenger compartment noise level has been reduced by the addition of insulation, which muffles noise transmission through the ventilation ducts.

Body shell joints for today's cars have been designed to simplify the application of sealers. Sealing materials are improved and the use of unpredictable blind sealers of the flowdown type has been eliminated on many cars.

To be more specific, seams and joints of the new Chrysler Corp. bodies have been designed to permit effective use of sealers. An elaborate system of internal drain troughs traps water and drains it from the car. Improved sealers are specified. Weather stripping is more durable and more effective.

Similarly, Ford door seals have been redesigned. Ford is using a unique rubber seal on the outside of the window glass channel. Ford rocker panels have ben redesigned for better draining.

Rustproofing has not been neglected in any of the new cars. Before the first primer coat is applied to the Edsel body, for example, the following operations are performed:

1. Cleaning.
2. Clear water rinse.
3. Clear water rinse.
4. Spray zinc phosphate film.
5. Clear water rinse.
6. Neutralize metal surface chemically.

Following this, two coats of epoxy primer are used, inside and out. Baking is at 350 F. Next, two coats of enamel containing 40% solid material and 60% solvents are applied.

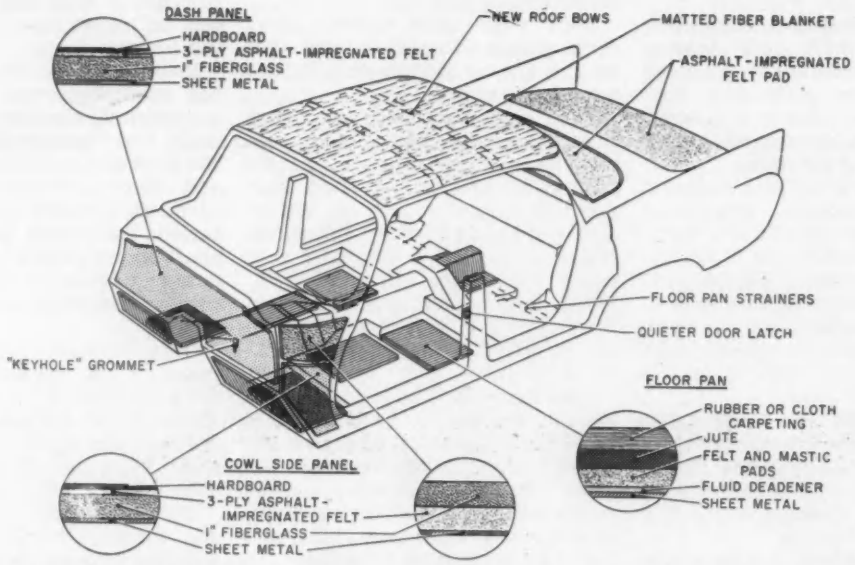
Body dipping is used extensively on all unitized bodies.

In addition to heavier steel gage, Chrysler is now using a series of seven dipping operations, plus six spray applications, to combat corrosion. A water-emulsion primer offers further protection. Dipping protects interior and exterior surfaces to a minimum height of 18 in. above the floor. Ford and GM also have extensive rustproofing programs.

More crown has been added to the front seat backs and to the rear seat cushions and backs for several Chrysler lines. In 2-door models, eight more coil springs are now used in front seat backs.

Chrysler's new automatic swivel seat swings out when the door is opened, swings back out of the way when the door is closed. On several models, the driver's seat back is higher than the balance of the seat back, adding support for the driver during long trips.

Chevrolet Corvair has introduced a folding rear seat which, when combined with available storage area behind the rear seat, creates a large storage area. This may be the first time this arrangement has been used on a U. S. car.



CHRYSLER UNIBODY FEATURES new keyhole grommet in dash liner, new insulating materials in floor pan and cowl side panels, and more effective use of roof silencers.

Spark plugs of new design may cure some 2-stroke engine ailments

Based on paper by

L. R. Lentz, R. F. Nostrant, and R. J. Craver
Champion Spark Plug Co.

TESTS with experimental spark plugs of unconventional design give promise of bringing to an end the plug failures that have plagued the development of high-horsepower, 2-stroke engines.

Most engine manufacturers have reported persistent trouble in engines of 25 hp and over which have not only high total horsepower but also high horsepower per cubic inch displacement. The failures noted are caused by gap bridging, bridging of insulator to shell (or insulator bridging), insulator deposit of low electrical resistance, rapid deterioration by corrosion of the electrode material, and occasional destruction of the plug firing end as a result of preignition.

Among the sets of spark plugs returned from field service because of unsatisfactory life in outboard engines of 25 hp or more, the operating data of 111 sets were known and these sets were examined to determine the cause of failure of at least one plug in each set.

Less than 10-hr operating time was reported for 35% of the sets. The highest percentage of failures, 53%, was attributed to either gap or insulator bridging. Next in importance was a deposit layer on the insulator of a type that will produce misfiring under high-spark-plug-temperature conditions. This accounted for 40% of the failures. The deposit is similar in appearance to the glazed deposit insulator surfaces seen on fouled automotive plugs, but the difference is in the deposit accumulation process. It isn't necessary for low power operation to be followed periodically by high power operation. As with gap and insulator bridges, this deposit is transferred from the other surfaces of the combustion chamber to the hotter insulator surfaces, where it melts down, forming a conductive glaze.

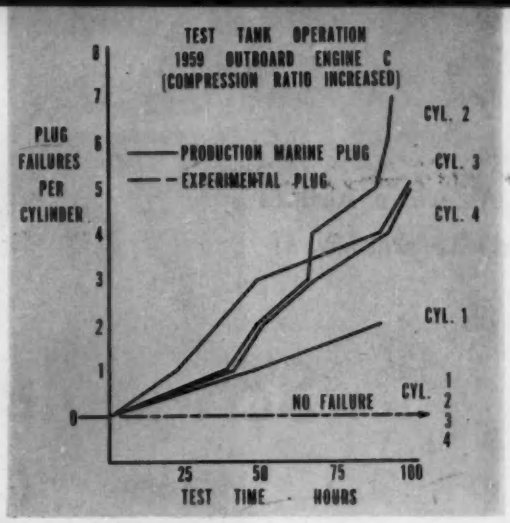


Fig. 1 — Possibility that spark-plug failures in 2-stroke engines can be alleviated by altering plug design is illustrated by results of 100-hr tests. When compression ratio of engine was increased 6%, there were 19 failures of production-type marine spark plugs, but none with the experimental plug of unconventional design.

The balance of failures, amounting to 7%, were of a miscellaneous nature. Three sets involved preignition, four sets had split insulators caused by center electrode deterioration and resulting expansion, and one set exhibited large gap growth.

Our approach to the deposit problem has been to accept the engines, fuels, and lubricants as they exist and look to the spark plug to solve the problem. The results thus far with an experimental spark plug have been encouraging.

To test the experimental plug under extreme conditions, one of the 4-cyl engines was altered to provide a plug failure incidence rate equivalent to that reported by an engine manufacturer as occurring with one of his 1960 model engines. The alteration was to increase the compression ratio 6%. Because unrelated types were used in two of the cylinders, only cylinders two and four were recorded. The test ran 100 hr and at the end of that period no failures were encountered with production cylinder heads. With compression ratio increased, there were 12 failures of the same production-type plug for the two cylinders.

When the experimental plug was tested under the same increased ratio conditions, there were no failures. Fig. 1 shows that the failures for the production marine plug totaled 19 for all four cylinders. Deposit shedding conditions did exist; there were 25 instances where the experimental plug misfired momentarily, apparently by deposit bridging, and almost immediately cleared itself. At 60 hr of test, the engine speed dropped below the allowable low limit. In checking out the engine with a production-type plug to determine if the experimental plugs were the cause, five plugs bridged out immediately. The power loss was found to be the result of exhaust port clogging.

Although this experimental spark plug performs remarkably well in tests of this kind, there are other problems associated with it. The type of spark-plug failure being experienced is extremely difficult to eliminate by development, but it is believed that progress has been made and will continue.

To Order Paper No. 123V . . .
. . . on which this article is based, turn to page 6.

How American Airlines solved the problem of

Scheduling Payloads and Flight Times for Jets

Based on paper by

F. W. Kolk, American Airlines, Inc.

WOULD the 707 jet be able to carry a full payload nonstop from New York to Los Angeles when the service was introduced? Despite the best of planning, serious doubts arose shortly before flight was inaugurated.

In the three years that had elapsed since establishing the fuel system, take-off gross weight, and airport characteristics, flight conditions had changed. Positive control of air space occupancy coupled with airway congestion and flight separation had combined to increase practical range requirements by some 20% over the Great Circle optimum range flight, not counting the effects of head winds.

Posed in simple terms, this was the problem giving rise to doubt. If we assume averages for the payload, the wind aloft, the fuel reserve, and ground temperature, we can make the flight handily with a fair amount of margin. However, if we assume a full passenger load, not quite the worst wind on record, optimum altitude blocked by other traffic, and the fuel reserve necessary to carry when it is raining in Los Angeles, the sum of the parts becomes greater than the whole and the passenger load tends to dwindle to insignificance. Moreover, in operating a jet, such things as exact choice of flight altitude become quite important to the resulting flight time and fuel requirement. Some reasonably consistent allowance for off-altitude operation must be built into any scheme of calculating payloads and flight times.

The Monte Carlo method

It is possible to get data on such things as frequency distribution of wind, temperature, occupancy of altitude, routings, and fuel reserves, and compute a flight plan for every combination of these factors. The possible combinations approach truly astronomical numbers and we needed some scheme of calculation which would combine the relative likelihood or probability that certain combinations of circumstances would occur. We chose the Monte Carlo method.

Table 1 illustrates the complexity of the payload-block time problem. Each item is significant in the conduct of the flight and each is subject to almost infinite day to day variation, and the frequency with which certain values appear can be expressed by probability curves. The distribution of any item can be expressed in the form of several sets of unique values, each of which is equally likely to occur. The number of individual values used to express this distribution reasonably is the degree of freedom of the variable. Obviously, the product of all the degrees of freedom represents the total number of equally likely environments in which flight could be conducted. Presumably, if we would calculate the flight plan for each combination, we could use the results to make a smooth probability curve for the actual operation.

Simplifying the complex

There are two problems with the above procedure. First, the total number of possibilities is 5.29×10^9. Second, for a given flight, only two altitudes can be used — one for each half of the flight. In choosing altitudes, the best combination will be used, but the best must be based on the best available in the light of airway congestion.

By resorting to a sampling technique, we make a practical problem out of a mess. The technique resembles a roulette wheel which has many numbers, each of which is equally likely to show. We pick a value of each variable by giving the available values index numbers and then spin the wheel to get the one to use. Actually, we use a table of random numbers to generate the index digits.

If a sufficiently large number of situations are developed in this manner, the results are quite representative of actual operations. Thirty cases or situations were found to be adequate for most work. In effect, the complete environment and management of each of 30 flights were duplicated by mathematics. The results were plotted as probability curves of flight time resulting from 30 situations, exactly as actual flight times would have been plotted. The appropriate schedule times from the probability curves were used as the basis of pub-

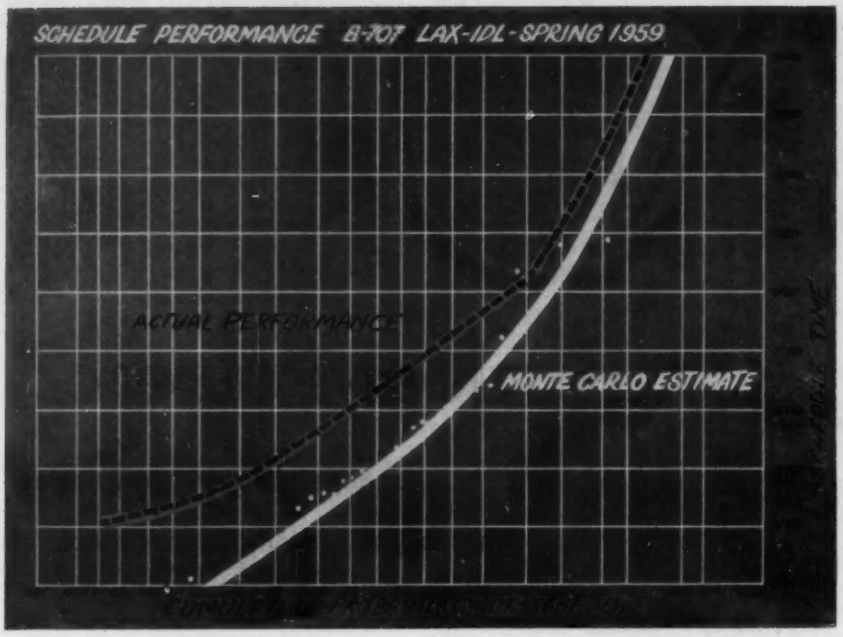


Fig. 1 — Curve of flight times based on probability study when matched with curve of actual performance shows success of the Monte Carlo technique.

lished schedules. A corresponding plot of payload probabilities was used to determine the committed load.

Committed load and schedule time are not mutually exclusive. One can, within some limitations, increase the committed load at the expense of schedule time or vice versa. The choice of schedule was based upon a compromise which favored speed rather than payload in the belief that the basic commodity an airline has for sale is speed. The study shows circumstances could conspire to prevent completion of a nonstop flight, but this was sufficiently unlikely to warrant passenger restrictions at the outset.

Success of the technique

Fig. 1 illustrates the success of the predictions. The general characteristics of the operation were well anticipated on the average. Block time was missed on certain routes, usually because the estimates for such items as ground time and en-route delays, which were fed into the calculation, turned out to be incorrect. Payload estimation was better because it was possible to carry the committed payloads on all routes but these loads could not be increased subsequently beyond the original limits.

What results is a valuable, though cumbersome, tool for the operational investigation of critical flight legs. The complication of this approach is not warranted under conditions where no real trade exists between payload and flight time. The Monte Carlo analyses constitute a very complete paper jet operation with provisions for simulating such interferences as blocked altitudes due to traffic control, circuitous routings for like reason, variable payloads, and changing conditions at point of take-off. Hammered out under duress, it will be improved upon for future use.

To Order Paper No. 110V . . .
. . . on which this article is based, turn to page 6.

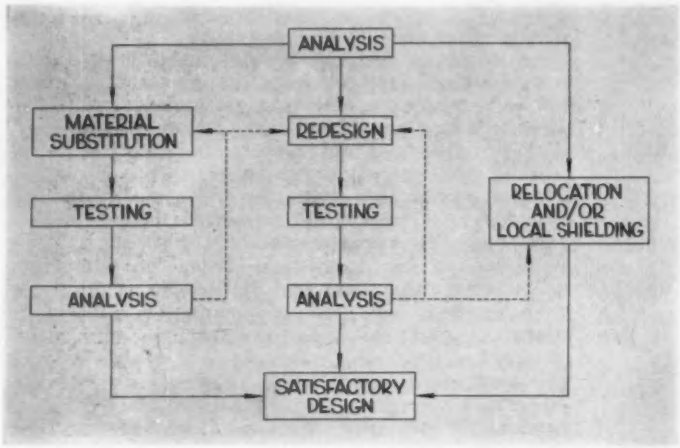
Table 1 — Monte Carlo Analysis Program for Determining Payloads and Flight Times

	Take-Off Surface Weather	En-Route Wind	En-Route Temperature	Route Distance	Available Fuel	Fuel Over Destination	Payload Available	Delay
Degrees of Freedom	30	10	10	6	49	3	20	100
Distribution	Random from available records	Normal	Normal	Estimated	Blocked at random	Estimated by weather records	To produce 85% load factor	Negative exponential
Controlled by Flight	No	No	No	No	Yes	No	No	No

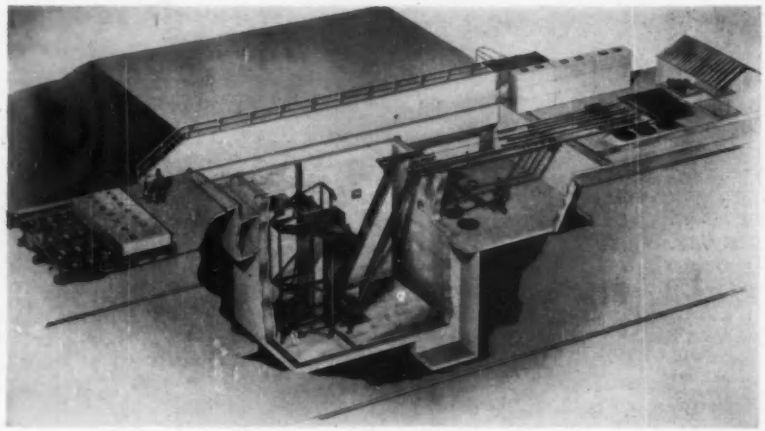
Effective radiation-resistant equipment is proving hard to develop for . . .

Nuclear-Powered

. . . but hopeful signs are appearing. that may solve many existing problems



Subsystem development can be through material substitution — the most desirable method, redesign, or relocation or partial shielding.



Facility for irradiating the assemblies. System is a modified swimming-pool reactor facility with provisions for remotely locating test specimens next to the reactor.

Aircraft

Specific program is suggested in this area.

● Here's a brief course on how radiation damages materials . . . for the aircraft equipment designer called upon to develop radiation-resistant subsystems for nuclear-powered aircraft.

Based on paper by

J. J. Tierney

Senior nuclear engineer
Convair Division, General Dynamics Corp.

ALL studies so far indicate that almost insurmountable difficulties lie in the way of the development of radiation-resistant equipment for nuclear-powered aircraft. For example:

- Organic materials may form gases that are explosive and/or corrosive.
- Organic fluids suffer a change in viscosity; radical increase in neutralization number; decrease in oxidation stability, lubricity, and flash point; particle formation; and gelation.
- Organic solids experience an increase and then a decrease in tensile strength, decrease in elongation, embrittlement, increase in compression set, decrease in peel strength, and decrease in dielectric strength.
- Electronic parts suffer permanent degradation to a greater or lesser extent.
- Metals suffer decreased elongation, increased hardness, and decreased ductility.
- Glass, such as might be used for lenses and TV screens, darkens, so that less light is transmitted.

Things are, however, not really so grim as this recital of some of the untoward effects of radiation might indicate. Already, a number of hopeful signs have appeared. For example:

1. Many plastics exhibit greater radiation resistance than elastomers.
2. The medium in which a material is irradiated

(continued on page 47)

The radiation environment of a nuclear-powered aircraft is basically made up of neutron and gamma radiation. Each has a wide energy spectrum and an average energy of about 1 Mev. Figs. 1 and 2 (shown on page 46) show these spectra for the ground test reactor.

Fig. 1 is a plot of the differential neutron flux versus energy. The plot has been segmented over different energy intervals and the integrated differential flux is shown for each interval. Fig. 2 contains plots of both neutron and gamma differential flux. The energy range shown contains those portions of the neutron and gamma radiation which contribute significantly to radiation damage.

Energy transfer

Neutron and gamma radiation energy transfer to a material or accessory resulting in damage is accomplished in the different processes discussed below:

Neutron Energy Transfer — Neutron interaction with matter is varied and complex. In the study of radiation effects, however, there are only two important types of interactions. These are (1) elastic scattering and (2) absorption by atoms of the bombarded material, resulting in transmutations of the atoms, accompanied by secondary radiations of widely varying types. In general, the damage to a material from transmutation of atoms can be ignored and the secondary radiations are important only in consideration of hazards to personnel.

Elastic collision is a billiard-ball type of collision between a neutron and the atoms of a material, in which energy and momentum are conserved. The average energy transferred to an atom by a neutron in an elastic collision is a function of the incident energy of the neutron and the mass of the struck atom. The greatest transfer of energy is with the lighter elements, that is, those with small mass numbers: the heavier the element, therefore, the smaller the average energy decrement of the neutron per collision.

The energies of the neutrons emitted by a reactor source are sufficient to displace the atoms in a material with energies capable of causing secondary displacements and ionization. The extent of damage suffered by a material from neutron bombard-

ment is, consequently, a function of its sensitivity to atomic displacements and/or ionization.

Gamma Energy Transfer — The transfer of energy from gamma rays to a material is accomplished by three different processes: (1) photoelectric effect, (2) Compton scattering, and (3) pair-production.

The photoelectric effect is the collision of a gamma ray with electron, in which there is a complete transfer of energy to the electron, resulting in the disappearance of the gamma ray.

The Compton effect is the collision of a gamma ray with an electron, in which there is only partial transfer of energy to the electron; this results in a scattered electron and a gamma ray degraded in energy by an amount equal to the energy transferred to the electron.

In the third process, pair-production, the incident gamma ray is transformed into an electron and a positron (positive electron), a reaction requiring a threshold energy equivalent to two times the rest mass of the electron (M_o) times the velocity of light squared (c^2), or 1.02 Mev. The total kinetic energy of the resulting electron and position is roughly equal to the energy of the incident gamma ray minus the energy required for the transformation, $2M_oc^2$. These particles then undergo collisions with other electrons until they approach thermal equilibrium with the medium, at which time the positron combines with an electron and the two disintegrate into two photons, each having an energy equal to M_oc^2 or 0.51 Mev.

The relative importance of these three processes is a function of the gamma-ray energy and the atomic number of the bombarded material. The photoelectric effect is predominant at the lower gamma energies up to approximately 0.7 Mev. As the energy of the incident gamma ray increases, the Compton effect becomes predominant — between about 0.05 and 11 Mev. As previously stated, pair-production cannot occur below 1.02 Mev and becomes increasingly important as the energy of the incident gamma ray increases.

The effect of each of these processes is to ionize the bombarded material. The damage to a material through gamma energy transfer is, then, a function of the sensitivity of the material to ionization.

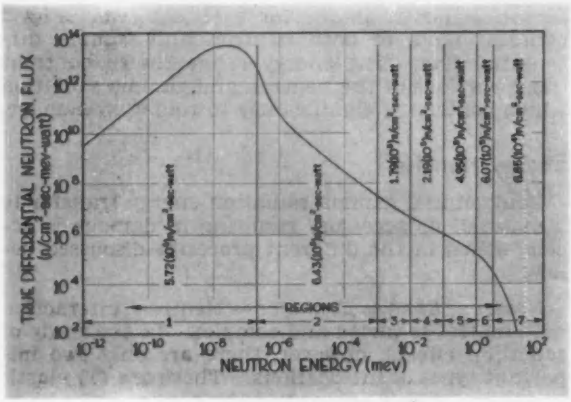


Fig. 1 — Ground test reactor neutron spectrum.

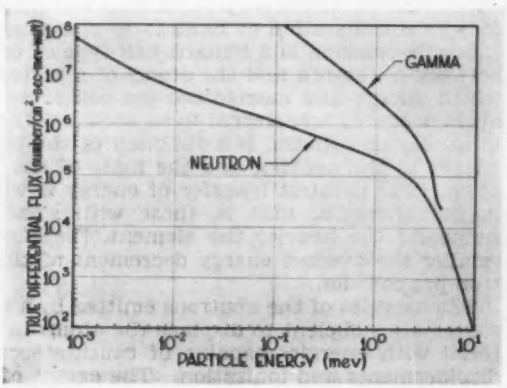


Fig. 2 — Ground test reactor neutron and gamma spectra.

Chemical Bonds — The relative importance of neutron and gamma radiation in causing damage depends upon the susceptibility of the material to change, either from atomic displacements or from the effects of ionization. The material's susceptibility to damage from either means is determined by the type of chemical bond holding the atoms of the material together. Three types of chemical bonds are considered when classifying materials: metallic, ionic, and covalent.

Metallic bonds: A metallic bond consists of a lattice of positive ions whose outer-shell electrons are free to migrate. Because of the mobility of the electrons in metals, ionizing radiation has no effect except to produce heat. On the other hand, the properties of metals are very dependent on the lattice structure; imperfections produced by the displacement of atoms from their normal positions in the lattice can cause significant changes in the properties of the material. When considering the damaging effects of radiation on metals, it is apparent that only neutron radiation is important.

Ionic bonds: An ionic bond is one in which electropositive and electronegative atoms transfer electrons and the atoms are held together in a lattice of negative and positive ions by electrostatic forces. In ionic-bond materials, ionizing radiation will eject electrons from the ions, leaving free atoms or positively charged ions, but not affecting the lattice structure. In most cases, electrons migrate back to the atoms and recombine with them to form the normal state. However, the electrons can be trapped at points of imperfection in the lattice and

form what are called "F-centers." These F-centers cause discoloration of the material, but have little effect on their chemical or physical properties. Neutron radiation, on the other hand, causes displacements of the atoms in the lattice structure and consequent changes in the physical properties of ionic-bond materials, as in the case of metals. The relative importance, therefore, of neutron and gamma damage depends on the material and its application. When a material is required to retain its structural properties, the damage produced by neutrons is most important. On the other hand, gamma damage is very important in optical elements. In this instance, the production of F-centers, resulting in decreased light transmission, makes ionizing radiation most important.

Covalent bonds: A covalent bond consists of molecules made up of electron-sharing atoms, the molecules being held together by weak van der Waals forces. Organic compounds as well as most common gases and liquids fall into this category. The ionization caused by neutron or gamma radiation is sufficient to break these covalent bonds, producing atoms, different molecular groups, and, sometimes, different chemical bonds. The mechanism of damage in these materials is complex and it is not always possible to predict whether neutron or gamma radiation contributes more to damage. Both forms of radiation must be considered significant until data exist from which the relative importance can be ascertained. Their relative importance is certainly a function of the neutron-to-gamma ratio.

Property changes after irradiation

In the study of radiation damage to metallic- and ionic-bond structures, the process of annealing is an important consideration. A distorted lattice is thermodynamically unstable and atoms free to migrate will return to their normal positions in the lattice, removing the effects of neutron-caused displacements. The degree of annealing depends upon the material and its temperature. Some annealing occurs in most metals at room temperature, whereas in materials such as ceramics, elevated temperatures are required before significant annealing occurs. Also of importance is the possibility of chemical changes continuing to take place in covalent-bond materials after irradiation. This could occur if, in the material under irradiation, the rate of certain chemical reactions occurring as a result of irradiation were a function of the number of free radicals being formed during irradiation. Such reaction rates can be strongly dependent upon temperature.

It is apparent that, if these conditions exist, property changes recorded after irradiation could possibly be a function not only of the irradiation conditions, but of the storage temperature of materials after irradiation and the time after irradiation at which the measurement is made.

continued from page 45

has an effect on the amount of damage sustained by organic materials.

3. The amount of damage sustained by the electronic parts tested varied appreciably with the manufacturer. This indicates a definite need to study materials and processes used in manufacture of parts to determine which yield more radiation-resistant parts. More need than ever exists for strict control over material and processes, as well as for well-established quality control programs, to ensure product uniformity.

4. Metals are damaged only at very high radiation levels, such as in the immediate vicinity of the reactor. The only other problem with metals is activation from neutron absorption, which means consideration must be given to neutron absorption cross-sections of metals being considered for radiated areas.

5. Ceramics are far superior to organic materials in radiation resistance, which makes them likely candidates as electrical insulating materials in radiated areas in aircraft.

Program suggested

A program for helping solve some of the many problems should include the following:

1. Fundamental studies — theoretical and experimental studies to improve our understanding of mechanisms of radiation damage.

2. Material and electronic parts damage studies to (1) screen existing material, (2) provide design data on the more promising materials, and (3) supply information necessary to the understanding of environmental interactions.

3. Subsystems damage studies — three courses of action are available for improving radiation resistance of existing or proposed designs (see upper illustration on page 44: (1) material substitution — the most direct procedure and the least costly, when it is possible; (2) redesign; (3) relocation and/or partial shielding — as a last resort.

Convair is now studying material substitution in the following seven subsystems: hydraulic, fuel, oil, fuel-quantity-measuring subsystems, gyro and accelerometer panel, air conditioning subsystem, tire and brake assemblies (see lower illustration on page 44).

This will not provide all the solutions needed, of course, but as data are obtained and analyzed, redesigns can be figured out and, if necessary, relocation and/or shielding considered.

. . . To Order Paper No. 107T . . . on which this article is based, turn to page 6.

More engine power; well-designed implements characterize a rapid engineering development of . . .

Soviet Tractors

Excerpts from paper by

Wayne H. Worthington
John Deere Tractor Research and Engineering Center

MANY interesting prototypes and pre-production tractors are currently under large-scale testing or in pilot production in the Soviet Union. Progress on these development projects is rapid, partly because there is no need for them to be "profitable" to the plant engaging in the work.

Progress is being made especially in four areas:

1. Increase in power, with higher power-to-weight ratio.
2. Developments necessary for use with implements and machines suited for higher operating speeds.
3. Aircooled engines free from the hazard of freezing.
4. Improved "implement carriers," otherwise termed "self-propelled chassis," which are intended for use with a wide variety of tillage and harvesting machines.

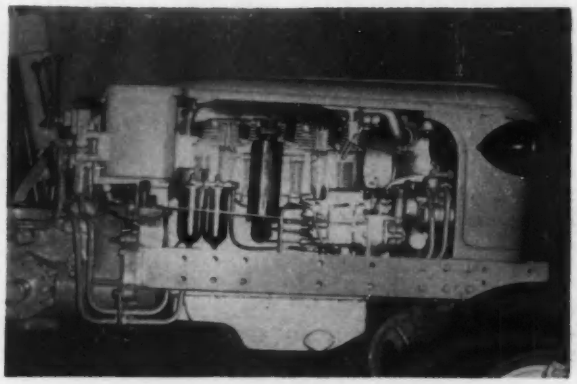


Fig. 1 — Recently exhibited Soviet 4-cyl, 40 hp, aircooled tractor engine.

Increased power

At least 10 examples currently available indicate clearly that the power of Soviet tractors can be expected to increase in every design category. Here is some of the evidence:

1. . . . A pilot quantity of 25 model DSSh implement carriers has been produced. These are powered with 2-cyl, aircooled 4-stroke diesel engines, 3.62-in. bore and 4.72-in. stroke, which develop 20 hp at 1750 rpm.

2. . . . What appears to be a model DT-28 chassis, powered with a 4-cyl, aircooled diesel engine of the same series as above, has been exhibited. On the basis of 10 hp per cylinder at 1750 rpm, this will increase the power of this successor of the DT-28 from 32 hp to 40 hp. This engine is shown in Fig. 1.

3. . . . A new 4-cyl engine (designated D50) has been under extensive development as a replacement for the present D40 engine used in the Byelaruss, Kirovitz KP-38, and other Russian tractors. This engine has a 4.33-in. bore and its stroke has been shortened from 5.12 to 4.72. A speed increase to something like 1800 rpm is contemplated.

At a conservative estimate, this engine should develop 55 hp in place of the 40 hp developed by its predecessor. Experimental tractors (designated as E50), using this engine have been built by the Dniepropetrosvsk Machine Works. They have been tested at the Northern Caucasus Machine Testing Station, where very favorable performance is reported.

4. . . . Already announced is the DT56 crawler tractor — as a successor to the DT54. This tractor is powered with a lightweight 4-cyl. diesel engine of 4.52-in. bore and 5.11-in. stroke. It develops 55 hp at 1500 rpm and 65 hp at 1700 rpm, with a claimed specific fuel consumption of 0.424 lb per hp-hr. The engine weighs 1210 lb, as compared with the model D54's 2430 lb. (The D54 is currently used in the same tractor). This new engine makes possible reduction in the operating weight of the tractor from 11,890 lb to 10,615 lb.

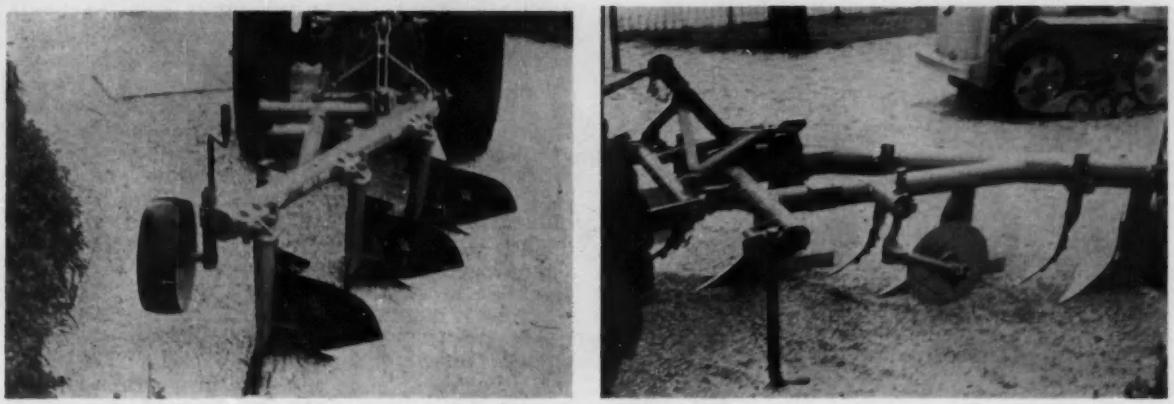


Fig. 2 — Among many Soviet prototype implements of advanced and cleancut design are a 3-bottom integral plow with welded tubular frame. On the left is shown a rear view; on the right, a side view.

It is built at the Sickle and Hammer Works in Kharkov and is essentially the same as the engine used in the SK-3 combine.

5. ...A new engine developed by the Kharkov Tractor Works (designated D70) has the same 4.92-in. bore as does the present D54 engine used in the DT54 tractor, but with the stroke decreased from 5.98 in. to 5.51 in. This engine weighs 1540 lb and develops 70 hp at 1500 rpm. (A crawler tractor powered with this engine was extensively tested in 1958 at engine speeds up to 1800 rpm.)

6. ...A new implement carrier — powered by a model DV aircooled, 4-cyl engine has been displayed by the Lipetz Tractor Works, which previously has built only tractors. The engine, developed earlier by the State Scientific Tractor Research Institute, uses a single blower, similar to that originally developed by Klöckner-Humboldt-Deutz in Germany. Its bore is 4.13 in.; its stroke, 5.11 in. It weighs 1144 lb, and its rated output is 50 hp at 1500 rpm. Specific fuel consumption is 0.408–0.413 lb per hp-hr. Since the piston speed is a conservative 1290 fpm, a substantial increase in power is possible.

7. ...The Vladimir Tractor Works has also shown a conventional standard-tread wheel tractor powered with the same 4-cyl, aircooled engine used by the Lipetz implement carrier.

8. ...A new crawler tractor (designated S-140) has been shown by the Tchelyabinsk Tractor Works, whose largest previous production tractor was the model S-100. This new tractor is powered by a 6-cyl, water-cooled diesel of 5.71-in. bore and 8.06-in. stroke. The engine develops 140 hp at 1100 rpm. This tractor uses low-cost, cast manganese steel tracks and appears to be intended for agricultural and logging service.

9. ..."Rostelmash," the Rostov Combine Works, is developing a self-propelled implement carrier powered with the SMD-65-hp engine regularly used on their SK-3 combine. Several large integral implements — including combine, corn picker, and hay baler — have been experimentally built for use with the machine.

10. ...Minsk Tractor Works has undertaken design of a self-propelled implement carrier powered with the model D40 engine used in the Byelaruss tractor.

Implement development

Many prototype implements of advanced and cleancut design are in operation at the machine testing stations throughout the Soviet Union. Fig. 2 shows an integral plow with a welded tubular frame. Although functionally deficient, the simple, clean frame design evidences original thinking and a new approach to tillage tool design.

Other advanced work in tractor design, including infinitely variable speed transmissions, is in progress at the State Scientific Tractor Research Institute. Similar work on implements is being handled by the All-Union Research Institute for

AUTHOR Wayne H. Worthington here makes his third 1959 contribution to SAE Journal's series of articles on Russian automotive engineering developments on the ground and in the air. . . . Last fall, Worthington traveled 9000 miles through the USSR as part of a 6-man Scientific and Engineering Team sponsored by the U. S. Department of Agriculture. . . . His earlier reports for SAE Journal appeared in the February and March, 1959 issues. . . . Worthington has just gone to Germany as a permanent representative of Deere & Co. to participate in the guidance of all engineering for the two plants of the company's German subsidiary, Heinrich Lanz, A.G. of Mannheim, West Germany. He retired as director of engineering at John Deere Tractor Research and Engineering Center on Oct. 31.

Soviet Tractors

. . . continued

Farm Machinery. Both operate under the State budget. Many other institutes are engaged in similar activities.

Research personnel numerous

Little additional information is available regarding the Tractor Research activities, but the Farm Machinery Institute has a total staff of 790 people. This includes 350 graduate engineers and 47 with advanced engineering degrees, of whom three have doctorates. Of the engineers, 90 are women.

In the year ending August 1958, 70 prototype machines were built and tested in cooperation with implement factories throughout the country. The magnitude of this work is appalling, especially as compared with similar endeavors in this country. For instance, consider the Institute Strain Gage Laboratory, which is one of 15. This single laboratory alone has a staff of 20 people, 10 of whom are designers working on test equipment. This is twice the total number of people employed at the Soils Laboratory of the USDA, at Auburn, Ala. And the Auburn annual budget is $77,000 for personnel and $6000 for materials.

Red tape rampant

But in spite of brilliantly functioning institutes and the finest in research facilities, the overall design of Soviet farm tractors and machinery is complicated, and development work is devious and badly fouled up with red tape. There is a lack of continuing responsibility, as the following procedure clearly shows:

All research is done under the direction of the Academy of Science of the USSR and the lesser academies of the individual republics. The institutes develop principles and theory, and usually prepare working models, which are then field-tested by machine testing stations around the country. Following successful field test programs, projects are then turned over to specified construction bureaus for preparation of production designs. Some of these construction bureaus are located at the implement factories, but others are not. The individual construction bureaus are responsible to the Council of National Economy, which in turn is responsible to the GOSPLAN of the Republic or area in which it is located. These, in turn, are responsible to the GOSPLAN of the Council of Ministers of the USSR. Before any new tractor or other farm machine can be placed in production, it must have had the approval of the Scientific Council of the Ministry of Agriculture.

At best, the mechanization of agriculture in the USSR is spotty. At one large Siberian state farm (Sovkhoz), the harvesting of sugar beets was described as 100% mechanized. Tractor-drawn beet harvesters were used to top, lift, and pile beets and tops. A crew of three men was required, namely, one tractor driver, one man on the beet harvester to guide it down the rows, and one "operator" who was kept busy keeping the harvester unclogged and who manually dumped the beet and beet top baskets when filled.

In the United States, one man operates both the tractor and the beet harvester and the beets are mechanically loaded into a truck driven along side the beet harvester. But on the Sugar Beet State Farm, it was necessary manually to retop and clean the piled beets. Fig. 3 shows a crew of four women doing this work, with a labor expenditure of 25.4 (wo) man-hours per acre. And this for an operation described as 100% mechanized! In a similar "mechanized" operation the grain after combining, and before delivery to the elevator, is piled on a cement apron and manually handled into and out of the grain cleaner.

The degree and extent to which Soviet agriculture is mechanized is truly difficult to define and appraise. But one simple comparison is enlightening.

It is officially stated that, in the Soviet Union, 56% of the population live on farms. In the United States, although no exact figures are available, the farm population is approximately 12% of the total. This small percentage of our people not only produces food and fibers for this country, but great quantities are exported and a surplus is accumulated, which hangs ominously over our economy. On the other hand, free to draw upon the best thinking of the Western World, and with manpower and equipment for research and design and development of farm tractors and machinery far greater than in this or any other country, the rapid progress of agricultural sciences in the USSR can be readily understood. It may perhaps be best thought of as mobilization for the inevitable war of "peaceful competition" now being propagandized.

Fig. 3 — Scene on Soviet farm where harvesting of beets was described as "fully mechanized." Although one man operates the tractor and the beet harvester . . . and the beets are mechanically loaded into a truck, it takes 25.4 (wo) man-hours per acre of labor manually to retop and clean the piled beets.

To Order Paper No. 93U . . .
. . . on which this article is based, turn to page 6.

Ducted Fan Engine . . .

. . . has decided merit for supersonic jet transports in spite of poor propulsive efficiency at high aircraft speeds.

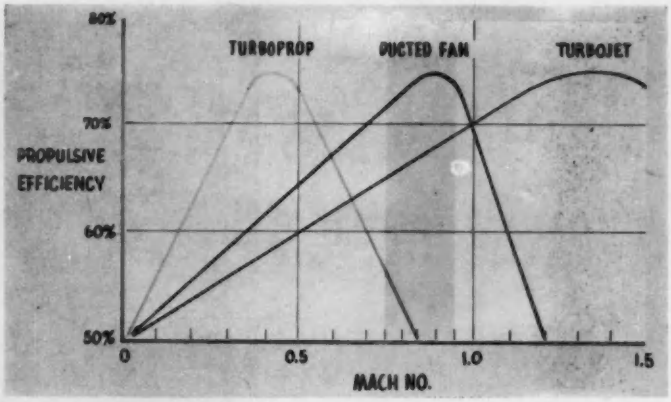


Fig. 1 — Comparison of propulsive efficiency of turboprop, turbojet, and ducted fan engines. Though surpassed by the turbojet, other characteristics make the ducted fan engine attractive for supersonic transports.

Based on paper by

Neil Burgess

and

A. P. Fioretti

General Electric Co.

THE ducted fan powerplant offers an excellent means of tailoring a basic gas generator to a multitude of different aircraft missions with the ability to optimize both the propulsive efficiency of the system and to optimize the thermodynamic cycle involved.

In overall propulsive efficiency the ducted fan engine stands between the turboprop and turbojet, as shown in Fig. 1. Its most important application at present is in subsonic logistic and transport aircraft for which it has been selected because of its superiority to the turboprop for high subsonic cruise and superiority to the turbojet in take-off thrust, cruise fuel consumption, noise level, and specific weight. A second and distinct application, now in its early stages of development, is for vertical take-off aircraft. And this leads to consideration of the lift fan for supersonic transport. With the wing area and the gas generator powerplants optimized for high-speed cruise, lift fans would provide the lift (or augment the wing lift) for short field, low noise level take-offs.

Why not for supersonic aircraft?

The ducted fan is often eliminated from consideration in the supersonic flight regime because of its poor propulsive efficiency at such high aircraft speeds. Nevertheless, it has some unique characteristics that make it very attractive for such applications. These are:

1. Higher take-off thrust with low noise levels.
2. High available thrust for climb and acceleration to supersonic speeds.
3. Low specific fuel consumption for holding.
4. Increased life and reliability due to the lower operating temperatures at cruise power settings.
5. Lower specific engine weight for equal cruise thrust.

Since aircraft noise on a commercial transport is a very important operating characteristic, it will undoubtedly be necessary for supersonic transports to take-off without using reheat. The ducted fan engine offers the required high take-off thrust in combination with an acceptable noise level.

For engines of the same dry take-off thrust, the afterburning fan can provide many times the thrust of the afterburning turbojet due to the large quantities of air available for combustion. Due to the lower afterburner pressure available, this is achieved at the expense of increased specific fuel consumption. If, instead of complete combustion of the available oxygen, the ducted fan engine is operated at a small percentage of the total reheat thrust available, an engine can be sized to provide the same cruise thrust as a full afterburning turbojet engine and provide greater take-off thrust at a lower specific weight.

Economical holding ability

Although the ducted fan engine would be flown at the low reheat settings for supersonic cruise, it could be used at the higher reheat values during a portion of the climb and for acceleration to supersonic speeds. In this manner, a very high thrust is available which improves the block speed and the overall mission fuel consumption by requiring less time for climb and acceleration to cruise speed.

Since supersonic transports must have the capability of holding during their normal mission to allow for landing delays because of weather or traffic problems, ducted fan engines will allow this transport to hold for the required period using much less fuel than a similar transport equipped with high-temperature turbojet or afterburning turbojet engines.

As experience is gained with ducted fan engines in supersonic flight, further refinements in the aerodynamic design of fan components undoubtedly will result in added improvement in the supersonic characteristics of the engine.

To Order Paper No. 103V . . .
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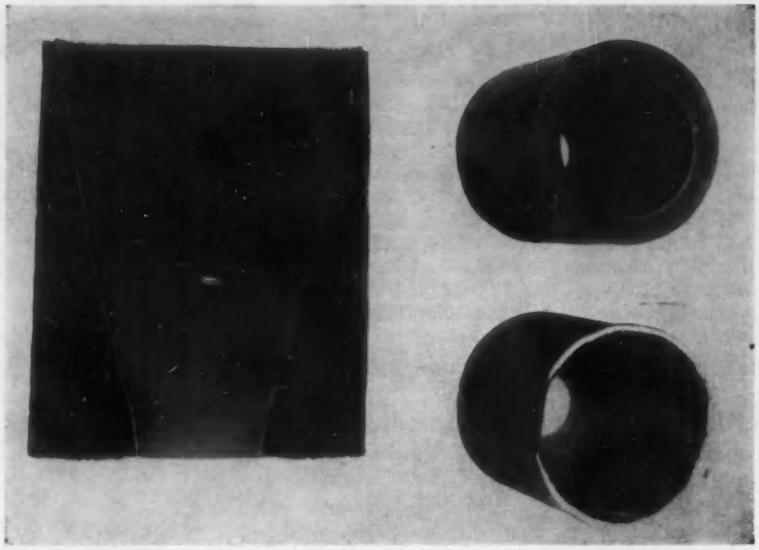


Fig. 1 — Refrasil-reinforced phenolic resin test specimen. (Right) before and after test. (Left) cross-sectioned and polished. A white silica deposit shows on the front face of the tested specimen.

Ablation Materials

Based on paper by **M. A. Schwartz**
W. Bandaruk and G. J. Mills
Aeronutronic Division, Ford Motor Co.

EVALUATION tests of ablation-type materials, one of the newest types to be studied for the missile industry, show them to have interesting aspects for ultra-high-temperature application.

Ablation materials have the characteristic of absorbing a relatively large amount of heat so as to decompose, liquefy, and/or vaporize as a surface phenomenon, while the interior of the material maintains a subcritical temperature and consequent structural integrity. In a sense, all materials have ablating characteristics under specific environmental conditions, but considered here are only those that:

- **Vaporize without a liquid phase, such as graphite or the plastics, the latter first undergoing thermal degradation.**
- **Vaporize from the liquid phase, such as ceramic oxides or metals.**
- **Composites, such as ceramic oxide reinforced plastics.**

AUTHORS **M. A. Schwartz, W. Bandaruk,** and **G. J. Mills** are all from Ford's Aeronutronic Division at Newport Beach, Calif. Schwartz, manager of the Division's Ceramics Section, has been active in high-temperature materials work for some 15 yr. . . . Bandaruk, manager of the Division's Plastics Section, came from Convair's Ft. Worth plant, where he was project engineering chemist. . . . Mills is manager of the materials department of the Division's Space Technology Operations.

Method of Evaluation

An oxy-acetylene torch, consisting of a W202 Oxweld torch butt with a 150-cfh multiflame tip, was used for the test. Copper cooling coils were wound around the torch to prevent overheating. The test specimen was held in a graphite holder which swings into position after the flame is adjusted. Outer surface temperatures were measured by spring-loaded thermocouples connected to a Minneapolis-Honeywell-Brown electronic recorder, while flow rates were measured by Fisher-Porter flowmeters.

Measurements were taken of the three I.D.'s of the specimen before and after testing, as well as the length, the volume change on the inside of the specimen, and the gross weight. Volumes were

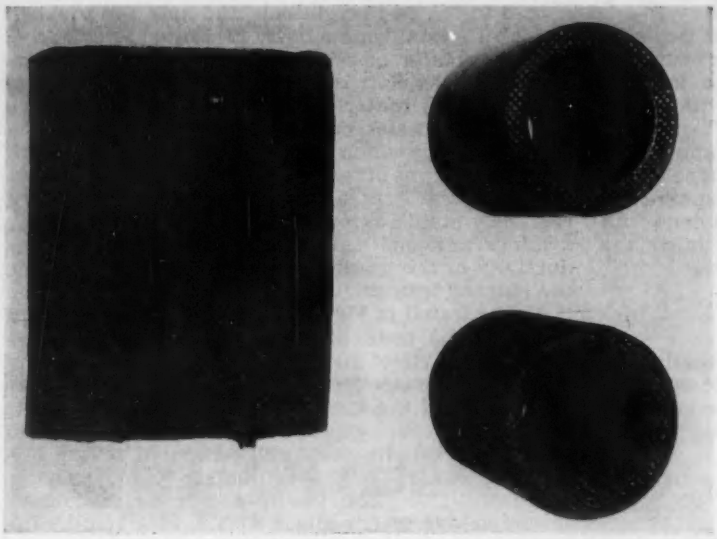


Fig. 2 — Graphite cloth-reinforced phenolic resin test specimens. (Right) before and after test. (Left) cross-sectioned and polished. Ablating surface is smooth and amount of ablation is low.

. . . are good for ultra-high-temperature applications in missiles, recent tests show.

MATERIAL	DURATION OF TEST (SEC.)	WT. LOSS (%)	W= %/SEC.	NOZZLE VOL. CHANGE (%)	NOZZLE DIMENSIONAL CHANGES (%) ID-1	ID-2	ID-3	APPEARANCE	HEAT TRANSFER BEHAVIOR
GRAPHITE (SOLID)	120	3	.03	12	3	1	1	UNIFORM	15
GRAPHITE (SILICONIZED)	135	1	.001	11	0	0	0	UNIFORM	14
BORON NITRIDE (SOLID)	120	(3)	.03	(-)	1	0	-1	SPALLING UNIFORM	19
REFRASIL-PHEN. (LAMINATED)	125	28	.22	72	30	35	16	UNIFORM	10
REFRASIL-PHEN. (CHOPPED)	120	47	.31	80	28	31	21	LESS UNIFORM	4
REFRASIL-NYLON-PHEN. (CHOPPED)	60	28	47	-	-	-	-	IRREGULAR	6
GRAPHITE-PHEN. (LAMINATED)	120	22	.18	5	4	1	-15	UNIFORM	8
GRAPHITE-NYLON-PHEN. (LAMINATED)	70	29	.41	2	3	-33	-55	IRREGULAR	14
GRAPHITE-REFRASIL-PHEN. (LAMINATED)	120	32	.27	48	35	-2	-13	UNIFORM	8
QUARTZ-PHEN. (RANDOM)	120	35	.29	102	56	65	23	UNIFORM	7
QUARTZ-PHEN. (RANDOM) (LONG P.C.)	120	25	.21	63	44	11	0	UNIFORM	8
FIBREGLASS-EPOXY (RANDOM)	60	27	.45	-	24	-13	-13	IRREGULAR	5

*HEAT TRANSFER BEHAVIOR: OUTER WALL TEMPERATURE IN 100'S OF °F (T.C.#2) AFTER 60 SEC.

Table 1 — Results of Oxy-Acetylene Torch Tests of Ablation-Type Materials.

measured by filling the inside of the test specimen with an epoxy resin of predetermined density.

A nozzle-type specimen was chosen for two reasons. It permitted observing the run-off characteristics of the material where a liquid layer is formed on the ablating surface. It also prevented cooling and oxidizing air from flowing or aspirating between the specimen wall and torch flame. The flame essentially encompasses the entire face of the test specimen, thus the nature of the atmosphere can be controlled by the ratio of oxygen to acetylene. All tests were run for approximately 120 sec unless the ablation was excessively rapid or irregular.

Results of tests

The various materials tested and the results are shown in Table 1. These results pertain to only one set of environmental conditions and are not necessarily applicable to other temperatures, atmospheres, or hot gas velocity conditions.

Fig. 3 — Irregular surface ablation occurring with fiberglas-reinforced apoxy resin.

The low ablating materials all proved highly resistant to the test conditions, and only the problem of high thermal conductivity presented itself.

Of the reinforced phenolic resin materials, a comparison of the Refrasil cloth (Fig. 1) and graphite cloth (Fig. 2) materials is of interest because two different processes occur. With Refrasil, a liquid phase develops which either vaporizes together with the resin or runs off as a liquid. With graphite, only the resin vaporizes. The graphite cloth should be relatively stable except for mechanical removal or a minor amount of combustion. The higher conductivity of the graphite cloth also tends to reduce the surface temperature of the material.

As illustrated in Fig. 2, the cloth forms a shingled effect as the resin ablates out from between the layers. This effect may also be a means of retaining the ablation gases for a longer period of time near the surface of the specimen so as to provide a heat block. This could explain the much lower ablation rate of the graphite cloth as compared to the Refrasil cloth, a 5% increase in nozzle volume as compared to 72%. The graphite plus Refrasil cloth specimen was intermediate with a 48% volume increase.

Effect of nylon addition

When nylon cloth was added to the Refrasil cloth or the graphite cloth-reinforced phenolics, the surfaces ablated unevenly, a build-up or swelling occurred at the lower end of the specimens, and an increase in heat transfer took place. It would appear that the test temperature is too low to completely ablate or vaporize the nylon and that a coking or graphitization process occurs which increases the conductivity. It is also possible that a similar explanation can be applied to the fiberglas-reinforced epoxy (Fig. 3) wherein the temperature is not high enough to vaporize the resin smoothly, while too high for the less refractory, less viscous fiberglas which runs off before completely vaporizing.

The long-time, low-temperature post-curing of the quartz fiber-reinforced phenolic (Fig. 4) provided a material which ablated at a much slower rate and to a lesser degree than the short-time, higher-temperature post-cure. A specific explanation for this occurrence has not yet been reached. The improvement resulting from the long-time post-cure is quite large, apparently indicating the sensitivity of the reinforced plastics to material preparation variables and to possible avenues of materials research.

To Order Paper No. 98T . . .
. . . on which this article is based, turn to page 6.

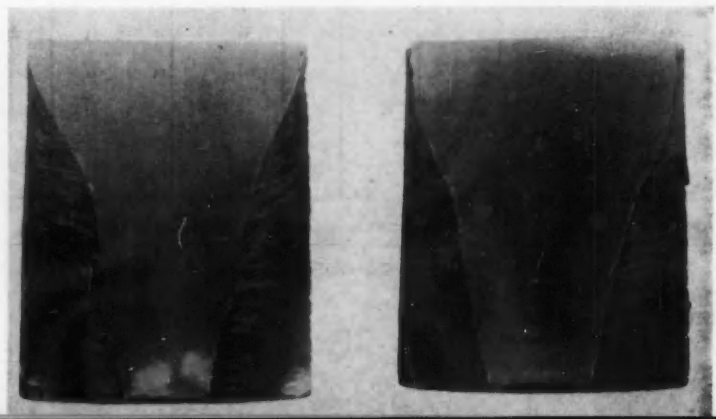


Fig. 4 — Quartz, fiber-reinforced phenolic resin test specimens. Rate of ablation is less and surface is smoother with long-time post-cured specimen at right, than with short-time post-curing shown at left. Both specimens are cross-sectioned and polished.

Corrosion is bane of fleet operators

Based on paper by

D. K. Wilson

Niagara Mohawk Power Corp.

CORROSION in truck fleets is a major problem and a costly one for truck operators. Whatever is done in the field to stem corrosion after taking delivery of a vehicle is of little value compared to anything done at time of construction, assembly, and painting of the chassis and body. Moreover, what is done at time of manufacture is liable to be destroyed in the field when repairs are made to the bumps, dents, and cracks to which all vehicles are subject.

Our vehicles are used in territory experiencing extreme snow and ice conditions and frequent high humidity. Condensation is a real problem. Road salts are used universally and generously; in some areas there are corrosive atmospheric conditions caused by a heavy concentration of electrochemical plants. We find corrosion beginning when a vehicle is from two to three years old and the trouble works from the inside out. The critical areas are seams, welds, depressions, joints, bottoms of compartments or any pocket in the body of cab where moisture can collect but cannot escape. As yet we have been unable to devise an effective and surefire method of overcoming deficiencies in design, construction, assembly, and preparation of metal and painting, all of which, together with road salts, contribute to corrosion.

Fleet operator experience

A check with other fleet operators, showed up a few who report no difficulty with corrosion. Among these are a large nationwide parcel service which uses bodies mainly of heavy aluminum sheet, and a dairy company in the Chicago area which uses bodies of galvanized steel, etched, primed, and painted with synthetic enamel.

An operator in the coastal areas of Florida and Louisiana reports, "Some of our most severe problems in the past have been caused by a well-known body manufacturer using great care in cleaning the steel and then leaving the unit outside over the weekend prior to painting." Operators in this area report satisfaction with aluminum bodies, although they have problems with the steel fittings, bolts, and the like, due to electrolytic action. One reports undercoating all vehicles and the bottoms of all lower compartments, even to the inside of truck doors. All report a problem in cleaning and painting drilled or welded surfaces after field repair in a manner to avoid recurrence of corrosion. One operator maintains a different painting schedule in coastal areas from that used 50 miles inland. And in all instances he tries to avoid overlapping seams and any type of material used for separating two metal surfaces.

Troubles with trailers

From the Midwest an operator reports corrosion of trailer equipment taking a greater toll than it does with trucks. He, among others, mentions corrosion of copper wiring, light sockets, and other items, and cites instances where the light-weight metal body of the trailer relay valve corrodes, leaving a powdery or flaky deposit floating around in the system to affect regulators and check valves.

Most of these reports come from east of the Mississippi River and parallel our own upper New York State experience.

To Order Paper No. 115V . . .
. . . on which this article is based, turn to page 6.

Air Force to leap-frog present aero systems to

New Energy Conversion

Based on report by

Richard Ling

Power Division, Aeronautical Accessories Laboratory, WADC

(Presented to SAE Committee A-6, Aircraft and Missile Hydraulic and Pneumatic Systems and Equipment)

NEW ENERGY CONVERSION TECHNIQUES will get the lion's share of research and development effort, reports the Power Division WADC. This leap-frogging over refinements in present aeronautical systems is necessitated by the expected requirement of coming space vehicles. The two main objectives of the program for "secondary" power systems are:

- **Longer duration of operation.**
- **Improved recycling characteristics at high temperatures.**

Chemical systems

In the immediate future, power requirements for durations up to approximately three days can best be met in most applications through chemical systems. In special cases, the trade-off point may be as gr .t as two weeks.

The state-of-the-art of chemical systems is not well advanced, either in terms of the attainment of usable space-type systems or of ultimate potential. Strong programs are needed in the areas of chemical dynamic system development and in fuel cell energy conversion research.

Fuel Cells — Theoretically, fuel cells can be considerably more efficient than the highest efficiency attainable with thermodynamic chemical systems. For long durations, where fuel weight is important, fuel cells could, therefore, be lighter. Eventually, over a wide range of powers and durations, fuel cells could provide the lightest of all chemical systems. Fuel cells are not reliable at present and are less efficient and heavier than the thermodynamic systems.

Fuel cells may be either nonregenerative, in which case the waste products are ducted overboard, or regenerative, in which case a smaller quantity of fuel is required and the fuel is continuously recycled. In the nonregenerative case, a high energy conversion efficiency is important to keep the amount of fuel required at a minimum. Hydrogen and oxygen appear to be the most promising, but a number of different types of fuels are under study.

The regenerative fuel cell, although theoretically sound, has not yet been reduced to practice. It is expected that systems can be developed in which fuels can be made to combine electrochemically to produce the required power, and then dissociate in a reaction chamber with the addition of energy. This energy could come from any thermal source, or could be photon energy from the sun or even radioactivity from an isotope or nuclear source.

For both regenerative and nonregenerative cells, research is needed on fuel and electrode materials and conversion processes.

Batteries — Improvement in secondary battery performance over many thousands of discharge cycles is highly important in the light of the vital role predicted for such batteries in all types of solar power systems. For high numbers of recharging cycles, current performance estimates range as low as 4 whr per lb, while 50–100 whr per lb, with 8000–10,000 charge-discharge cycles appear to be possible.

Chemical Thermodynamic Systems — The importance of fuel weight in long duration vehicles is vastly increased, which places prime emphasis upon energy conversion efficiency and use of higher energy fuels such as liquid hydrogen.

A considerable amount of work has been accomplished on non-air-breathing chemical power units for missiles. The following table shows typical present capability for this type of power unit:

	Liquid Fuel	Solid Fuel
Power Limit, hp	75	4
Specific Fuel Consumption, lb/hp-hr	6–8	8–10
Operating Time (Approximate)	1 hr	10 min

Research and development activity on air-breathing power sources has been cut in the past two years as effort on non-air-breathing power sources has increased.

Solar and nuclear systems

Many advanced vehicles will require power for durations achievable only through the use of solar, nuclear reactor, or isotope energy sources. For these long duration systems, the magnitude of power requirements, more than any other factor, affects the choice of energy source and of energy conversion methods.

Static energy conversion systems will probably

Techniques for Space Vehicles

occupy the low end of the power spectrum (below the 0.5–5kw range) and the dynamic systems the remainder. In the high power dynamic systems range, weight studies indicate that a solar energy source will usually be preferable below 25–50 kw and a reactor source is likely to be preferable above this range.

Nuclear Reactor Dynamic Systems — At powers of 25–50 kw, nuclear dynamic systems become competitive, weightwise, with solar dynamic systems, and are increasingly favorable as power is increased. With adequate development effort, a 25-kw unit, with a specific weight of 50–100 lb per kw, including shielding, may be obtainable.

Solar Dynamic Systems — It appears that solar dynamic power systems will have a weight advantage over all other long duration systems (solar and nuclear) in the range of 5 kw to approximately 25 kw. The lower end of this range may move upward if anticipated improvements in the conversion efficiencies of static devices are realized. The range, 5–25 kw, is important in that it encompasses many of the anticipated long duration satellite nonpropulsive power requirements for the next decade.

Solar dynamic systems studies and developments are challenging. The applied research areas encompassing concentrating collectors, zero-gravity boilers and radiators, higher efficiency turbines, generators, thermal energy storage, voltage and speed controls, and orientation systems, indicate the variety and scope of problems involved.

As used on satellites, solar power systems require an energy storage system. Thermal energy storage systems may have a decided weight advantage over batteries and are being investigated.

Photovoltaic Systems — For the low power range, photovoltaic systems are now preferred over other long duration solar energy conversion systems. This situation will continue until either thermoelectric or thermionic conversion efficiencies and weights become competitive.

Currently achievable conversion efficiencies of 10% and estimated system weights of 10 w per lb (above the earth's atmosphere) make practicable now (at very high cost) the use of photovoltaic systems on orbital vehicles. Highly desirable improvements are possible in the near future in cell conversion efficiency (15–18%) in system cost, and also in cell weight.

Thermoelectric Systems — Thermoelectric conversion offers the eventual possibility of a light, reliable, static means of transforming heat energy into electrical energy. At present, power units producing up to 100 w (with a specific weight of 2 to 3 w per lb) are considered to be feasible. Power units up to 1 kw having a specific weight of 50 w per lb may be feasible in approximately 5 years. The Navy (BuShips) is devoting effort to the development of high-temperature thermoelectric materials. It is believed that system weight reduction will be achieved through use of higher temperatures, new materials, and other means of improving device efficiency.

Thermionic Systems — The thermionic converter consists essentially of two plates which are separated by a gap. The heating of one plate causes electrons to be boiled off into the gap and to be collected by the other plate. Though thermionic converters are still in a research stage, a unit capable of producing 100–500 w (3–6 w per lb) could be built within two years. A 5-kw (22 w per lb) unit may be possible in five years. Potentially high conversion efficiencies of upwards of 25% are possible with thermionic systems, with either a solar or nuclear energy source.

Vehicle Power Needs

Advanced flight vehicles will fall into three power requirement classes:

Boost Glide Vehicles need large amounts of power during boost ascent and descent for hydraulic and pneumatic systems. At other times, power requirements will be largerly electrical. Chemical sources are expected to supply these needs for expected time durations of a few hours to a day or two.

Short Duration Satellite Requirements can also be largely met by chemical systems because of operating times of a few days to two weeks. Power ratings are not expected to be high.

Only solar and nuclear sources can be considered for **Communications, Reconnaissance, and Weather Satellites** because of long flight durations. Power levels will range from a few kilowatts to several hundred kilowatts.

Hardly any rock remains unchallenged now by . . .

HEAVY-DUTY Tractor RIPPERS

Based on paper by

C. R. Fahnestock and D. J. Larson
Caterpillar Tractor Co.

DEVELOPMENT of the heavy-duty tractor ripper makes it possible to rip and scraper-load materials that formerly had to be drilled and blasted. Consequent large-scale use of rippers on highway and other construction jobs and in mines has extended the use of tractor-scrapers and reduced the overall cost of moving dirt.

Originally designed to loosen hard pan, the ripper has evolved into a powerful tool capable of plowing through heavy rock formations. As the weight and horsepower of tractors have increased, so has the capability of the rippers. Now, in some areas, hardly any rock is unchallenged by them.

This upward extension of the range of rippable materials is shown graphically in Fig. 1.

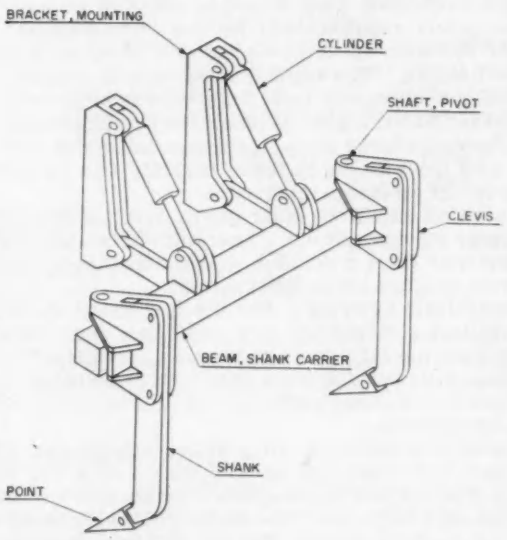
The tractor-mounted ripper extended the range, because of the additional weight that could be brought to bear on the ripper tooth. Tandem ripping adds the weight and power of a second tractor to extend the rippability range even further. Over the years, the increases in tractor weight and horse-

ALL RIPPERS contain certain common components. The beam, shank (or shanks), points (or tips), and hydraulic cylinders all fall into this category.

Virtually every design has made use of double-acting cylinders operated by a hydraulic power source to control the ripper. This is in contrast to the cable operation of the older towed ripper.

This system has enabled the ripper (1) to be carried on the tractor in a raised position, (2) to lift large pieces of rock from the ground, and (3) to use a portion of the tractor weight to help force the point into the ground.

This last feature plus the tractor compactness and utility obtainable with a mounted ripper are the principal advantages offered by this type of design. The major variables in design of mounted rippers are the mounting and linkage of the beam to the tractor and the method of mounting the shank to the beam. Shanks and points are also major components, but are relatively easily changed to match job requirements for a specific type of material.



BASIC RIPPER COMPONENTS

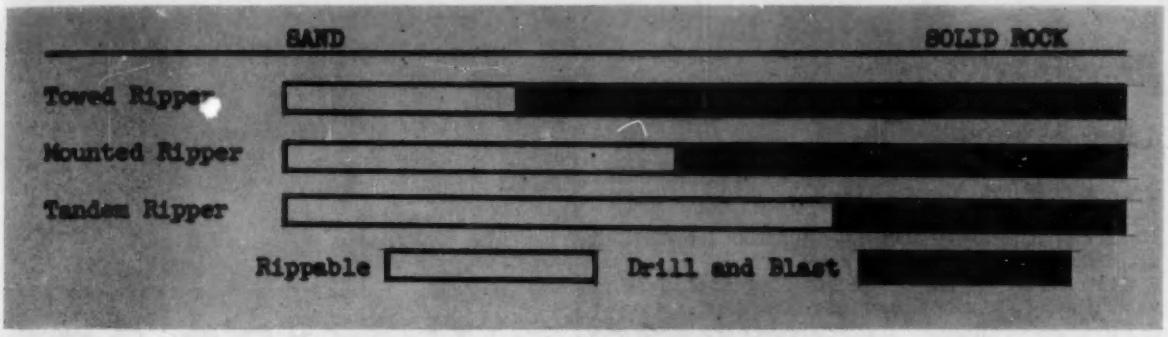


Fig. 1 — Range of rippable materials shown graphically.

power also made their contribution.

A comparison of ripping and blasting methods on a particular job is shown in Tables 1 and 2.

These costs were obtained on a job in Kansas that was regarded as typical of minimum costs encountered on an "easy" drilling and blasting job. Two tractor-mounted drills were used with a 600 cfm compressor, representing a total investment of $36,200 if the job were done by blasting and drilling. The costs of blasting and drilling are shown in Table 1.

The costs of ripping the sandstone on this same Kansas job are shown in Table 2. The tractor with

Table 1 — **Costs of Drilling and Blasting on a Job Regarded as Typical of Minimum Costs Encountered in an "Easy" Drilling and Blasting Job**

	Cost per Hr
Depreciation — Compressor for 12,000 hr, $1.53 Drills for 6,000 hr, $2.97	$4.50
Interest, Insurance, Taxes at 3¢/$1000	1.09
Fuel and Oil	0.80
Repairs, Including Bits, at 100% of Depreciation Rate	4.50
Labor, 2 Men at $2.40	4.80
Total Drilling Cost	$15.69
Production (average of 6⅔ holes per hr at 36 cu yd/hole) per hr	240 cu yd
	Cost per Yd
Drilling Cost (15.69/240)	6.5¢
Explosives and Primer, including 1 Man	7.9¢
Total Cost — Drilling and Blasting	14.4¢

Table 2 — **Cost of Ripping the Sandstone on the Same "Easy" Drilling and Blasting Job of Table 1**

	Cost per Hr
Depreciation for 8000 Hr	$7.19
Interest, Insurance, Taxes at 3¢/$1000	1.73
Fuel and Lubricants	2.28
Repairs at 100% of Depreciation Rate	7.19
Ripper Tips ($30 Tip with 10 hr life)	3.00
Operator	2.50
Total Owning and Operating Cost	$23.89
Ripper production (average of 8000 cu yd per 10-hr day)	800 cu yd
Ripping Cost per Cu Yd ($23.89/800)	3.0¢

Table 3 — **Examples of Relative Costs of Ripping as Compared to Drilling and Blasting on Typical Jobs**

Location	Material	Ripping Production, cu yd/hr	Ripping Cost, ¢/cu yd	Drilling and Blasting Cost, ¢/cu yd
Tulsa, Okla.	Limestone	250	7.3	17.3
Dallas, Tex.	Limestone	350	5.2	15.1
San Francisco, Calif.	Sandstone	400	15.0	30.0
Merriam, Kans.	Sandstone	1000	2.1	11.7
Nelsonville, Ohio	Sandstone	333	5.7	13.8
Chicago, Ill.	Limestone	460	6.5	—
Philadelphia, Pa.	Limestone	196	11.5	19.3
Carbo, Va.	Sandstone	300	8.6	15.7
Hibbing, Minn.	Frost	90	25.0	60.0
Hibbing, Minn.	Paint rock	350	6.1	54.5

Heavy-Duty

Tractor Rippers

. . . continued

No. 9-ripper and the necessary controls represented an original investment of $57,500.

Comparison of the cost of drilling and blasting with that of ripping shows an advantage of almost 5/1 in favor of ripping. But remember that this was an easy job — as evidenced by the relatively low cost of loosening the material by either method.

As would be suspected, the cost per year of ripped material varies inversely with the production obtained. Thus, for a machine cost of $23.89 per hr and an hourly production of 800 cu yd, the unit cost is about 3¢. On the other hand, in the extremely difficult ripping conditions found in frozen ground on the Mesabi Iron Range near Hibbing, Minn., the average hourly production was 90 cu yd. Machine cost under these difficult conditions was over $27 for a unit cost of 30¢ per yd. However, where ripping is difficult and costs high, drilling and blasting costs can also be expected to be high.

As a rule of thumb, it can be said that where rippers can be used on a production basis, they can loosen the material for one-third to one-half the cost of drilling and blasting. An even greater cost spread shows up in most cases . . . as evidenced by another job on the Mesabi Range, where rock was ripped for 10% of the cost of drilling and blasting.

Some other examples on typical jobs of relative costs of ripping as compared to drilling and blasting are shown in Table 3. This table listing of 10 jobs includes highway cuts, overburden removal, and rock quarries. It will be noted that the cost of loosening the material by ripping ranges from less than 12% to 60% of the cost of drilling and blasting. Worth mention also is that, in moving loosened material to its destination, the ripper-scraper combination effects an even larger saving over blast and shovel methods.

The total costs (including loading and hauling) on the Kansas job show that the ripper scraper method is 23.1¢ per cu yd cheaper than the drill, blast, and shovel method. Thus, on a 100,000 cu yd job, the cost differential would be $23,100.

Full utilization of the equipment available or already on the job should help to determine how the material is handled. Most earthmoving jobs involve the use of dozers and scrapers for a sizeable portion of the total yardage. If this equipment can be used to finish the job, it is not difficult to appreciate what savings can be realized.

The alternative is to move out the "earth" moving spread and bring in a rock spread . . . drills, explosives, shovels, and haul units.

It soon becomes apparent that considerable effort can be expended to rip the material in order to keep the scrapers on the job. This brings up the use of tandem ripping — which has been used successfully, although on a limited scale, in a number of areas.

To Order Paper No. 90T . . .
. . . on which this article is based, turn to page 6.

120,000

In Boeing 707

Based on paper by

R. M. Morgan

Boeing Airplane Co.

THE ABSENCE of major problems involving fundamental design of structure, aerodynamics, flight control, or powerplant has satisfied Boeing that the 120,000 man-hours spent on predelivery design improvement of the 707-120 Stratoliner was well justified. The scheduling of these man-hours is shown in Fig. 1.

Early in the program the basic configuration of the fuselage was modified to provide greater volumetric capacity through increased diameter and length. An increase in original diameter inches to give a total of 12 ft, 4 in. permitted comfortable six-abreast tourist seating, while the addition of 40 in. of length in the constant section forward of the wing and 80 in. aft provided room for more rows of passenger seats and larger cargo compartments. Modifications for over-water operation also were made.

Powerplant modifications

Several changes were made to improve performance, the most important being adoption of the JT3C-6 engine with water injection instead of the original dry JT3C-4. This resulted in better hot-day take-off performance. Design refinements to obtain range benefits included the addition of vortex generators on the wing and thrust recovery units for the outflow of cabin pressurized air. Toward the end of the program, leading edge flaps were added to that

Man-Hours Pay Off

Redesign Program

portion of the span between the engine struts on each wing, and hydraulically actuated in conjunction with the trailing edge flaps. This was done to increase safety by broadening the range throughout which the pilot could rotate the airplane prior to reaching V_R speed, and to improve climb performance.

Original magnesium skin in certain areas of the empennage was changed to aluminum alloy as a result of military service experience, which had shown evidence of sonic fatigue in these zones. Changes from magnesium to aluminum were also made in other areas, such as wing flaps and leading edges, cowling and dorsal fin, to lessen the possibility of corrosion.

Changes in systems

Shifting to wet engines necessitated the installation of wing center section water tanks for 4200 lb of water, with attendent submerged pumps, drains, plumbing, controls, and instrumentation for both diffuser injection and combined compressor diffuser injection.

Much design effort was expended in engineering many versions of self-sufficient starting systems to meet divergent customer requirements. The principal elements of all versions consisted of the addition of one or more combination high-pressure/low-pressure turbine starters, high-pressure storage bottle, combustor unit, air compressor, plumbing, and controls Last, but most important, was the thrust reverser/sound suppressor program. Prior to arriving at the production configuration of these units, several million dollars and about 435,000 man-hours were spent in design, test, and redesign, with the sound suppressor absorbing the lion's share.

The original electrical system was modified to incorporate brushless generators and increase galley power to 32 kw; the hydraulic system was modified from a four-pump crossover system to a simpler and lighter two-pump utility system plus an a-c motor-powered auxiliary system, and all components were standardized for use with Skydrol hydraulic fluid.

The pay-off

Although adding to the total cost of the 707, the predelivery changes resulted in a better airplane, as demonstrated by postdelivery experience. Hindsight examination would doubtless uncover some areas where the program could have been reduced, especially in certain cases, where increased standardization between all customers could have been achieved. However, the net result produced a refined product and a higher degree of customer satisfaction.

Postdelivery experience

As service experience accumulated, three broad groups of troubles, usually associated with all types of aircraft, became discernible. These were: (1) inadvertent flight maneuvers, (2) systems problems, as mentioned earlier, and (3) flight incidents resulting from system or component malfunction. Some of the inadvertent flight maneuvers occurred during training; others occurred during scheduled flight and received wide attention.

The most serious result of in-flight mechanical troubles were safely executed unscheduled landings. The unscheduled landing of a 707 with two main wheels missing at Idlewild airport was the most no-

Boeing 707 Redesign Program

... continued

torious. Here, repeated main landing gear snubber failures previously experienced on the landing gear involved, had caused successive impact loads on the truck beam and final failure due to crack progression. Modifications to the snubber assemblies, truck leveling cylinder, and automatic braking system were immediately engineered to prevent recurrence.

Loss of hydraulic fluid in flight has been responsible for the majority of unscheduled landings. In all such cases, the gear has been extended using the standby manual system, and landings made without further ado.

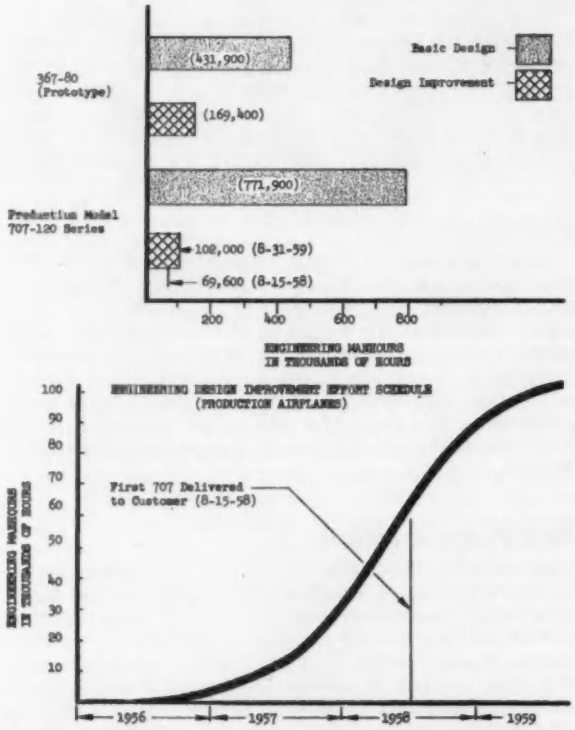


Fig. 1 — Graphic portrayal of engineering man-hours expended in direct design and predelivery design improvement on the Boeing 707–120 Stratoliner.

Sources of greatest trouble

The fuel and navigation systems loom largest on any list of malfunctions. The great majority of fuel system problems have arisen in the fuel quantity and fuel flow indicating subsystems. Vendor fixes for the former have been achieved, while the latter is under investigation. The bulk of navigation system malfunctions are attributable to poor service life on directional and vertical gyros and flux gate compasses, but product improvement is in progress.

From Boeing's standpoint the most troublesome systems have been the freon-type air conditioning and the hydraulic power. The complex and numerous freon-system troubles have been evidenced primarily by cabin temperature instability, pack trip-offs, and unsatisfactory ground cooling. To remedy the situation a cooperative program has been launched with vendors and airlines. The first phase of the program was to send a Boeing-vendor team to the field to retrofit delivered airplanes with 18 different system modifications. The second phase involved a 10-day flight test in high ambient temperature regions with an especially instrumented airplane to obtain additional data on airflow, pack performance, and electrical loads. The third phase involves evaluation and analysis of test flight results and modified airplane performance, followed by a longer range improvement program as required.

Faults in hydraulic system

There have been hydraulic leaks in connection with unscheduled landings. The primary cause for fluid loss has been the engine-driven pumps which have been subject to leaking shaft seals and internal failures. Spoiler actuation system leaks were traced to control valve O-ring troubles, which lent themselves to a simple fix. Air start compressor motor connection leaks led to the adoption of a flexible rather than a rigid tubing installation. An active program has been undertaken with the vendor to improve pump reliability, also added means of relieving pump case pressure, and increased filtration and improved tubing installations. Evidence of system contamination remaining from previous pump failures has also led the operators to tighten up on flushing procedures.

Water injection systems have never before been required to pump 700 gal in approximately 2.5 min, as in the 707. The principal service shortcomings of this system have been unsatisfactory life of the engine-driven water pump and the submerged electrically driven pump. A modified engine pump has been developed that promises reliability, while an active test program on instrumented airplanes and in the laboratory is expected to resolve troubles from the submerged pump.

Troubles from the water injection, air conditioning, and hydraulic systems are showing a downward trend in field reports and are expected to subside to satisfactory levels at an early date.

To Order Paper No. 110T . . .
. . . on which this article is based, turn to page 6.

Reservoir Is Key to New Missile Test

Overall hydraulic system performance is mirrored by reservoir level fluctuations.

Testing is simple for preflight and in-flight operation.

Based on report by

J. S. Worrell

Denver Division, The Martin Co.

(Presented before SAE Committee A-6, Aircraft and Missile Hydraulic and Pneumatic Systems and Equipment)

MISSILE HYDRAULIC system defects can now be spotted by a simple check of the reservoir level. The check can be made during preflight examinations or the method can be used as an inflight monitor of the whole system using only a single telemetering channel. The method doesn't preclude the use of other instrumentation, but rather, it gives an overall picture of hydraulic system operation — and when there is trouble, it tells the engineer where to look.

The principle of the method is that the reservoir level directly indicates the system fluid volume — and can give the load flow rate and a mirror image of the system pressure. This is possible because of the interaction between the reservoir and the accumulator. The only requirements are that the system be relatively simple, which is typical of missiles, that the reservoir level be free to fluctuate with variations in accumulator fluid volume and that the system be reasonably inelastic except for the accumulator energy storage.

It is not expected that there will be a weight penalty involved since a reservoir level measuring system may already be incorporated into the missile design to control the fluid level closely prior to launching.

There are two ways to interpret the data received. One is to compare it to data taken under controlled conditions and the other is to calculate what the results should be. In the second case, the dynamic characteristics of the system must be known.

Example system

The basic missile system shown in Fig. 1 gives all the elements necessary to use reservoir-level measuring as a checking technique. The volume of the reservoir varies with accumulator storage. Also, the reservoir is charged so its piston will not allow air or vapors to occupy volume. A linear variable resistor can be installed in the charging piston (see Fig. 2), to act as a transducer and supply a d-c voltage pro-

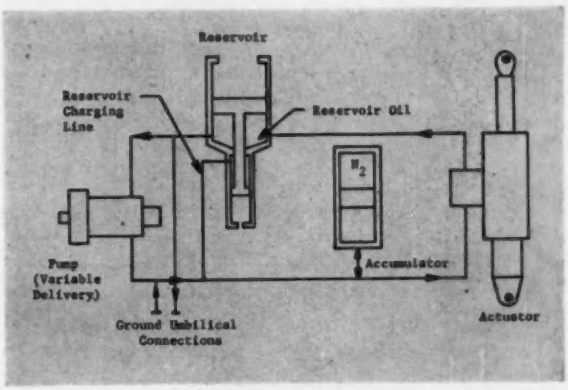


Fig. 1 — Simplified schematic of a missile hydraulic system shows basic elements that are necessary for reservoir level checking system.

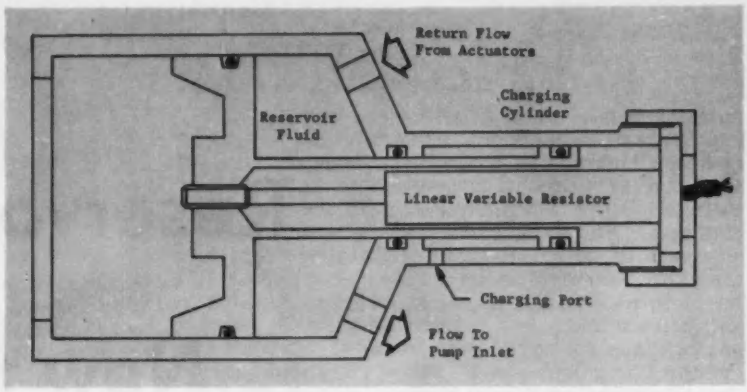


Fig. 2 — Information on reservoir level can be transmitted by attaching linear variable resistor to piston. When bootstrap system of charging is used, fluid volume in charging system also has to be considered.

Reservoir Is Key to New Missile Test

. . . continued

portional to the volume of fluid in the reservoir. The ground connections are typical of the outside hydraulic power supply available to missiles to perform ground function tests. In an actual missile, the main variation would be the addition of extra actuators.

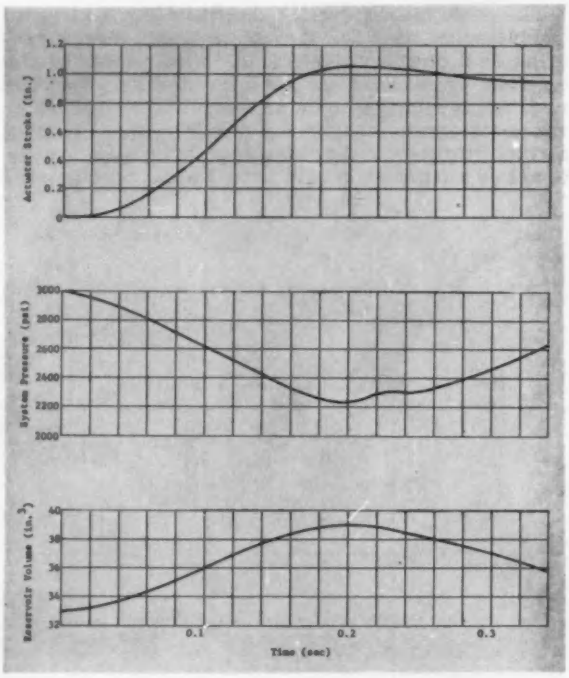


Fig. 3 — System transient for position step input to two servoactuators.

The only data needed for an analysis are:

- The time for reservoir level to go from a low to a high reading.
- Total reservoir volume change as it goes from low to high reading.
- The physical dimensions and characteristics of the equipment.

The test information can be obtained from a time plot of the reservoir level. The following two system parameters can then be calculated:

$$\text{Minimum system pressure} = P_0 V_0^k [V_0 + V_1]^{-k}$$

$$\text{Maximum load flow rate (less valve leakage)} = \frac{V_1}{2}(\omega_1 + K)\left[1 - e^{(-t_1/2\tau)} - \frac{1}{\tau\omega_1}\cos\left(\frac{\pi}{2} - \tan^{-1}\tau\omega_1\right)\right]$$

where:

P_0 = Nominal steady-state system pressure, psi
V_0 = Accumulator gas volume at nominal system pressure, cu in.
k = Polytropic expansion constant for accumulator gas
V_1 = Difference in reservoir volume from steady state to peak, cu in.
K = Scale factor relating pump discharge rate to reservoir volume change, 1/sec
t_1 = Time for reservoir to increase from steady state to peak, sec
ω_1 = Frequency of reservoir volume change $= \pi/t_1$, rad/sec
τ = Pump time constant, sec

As an example of the accuracy of the calculation method compared to actual test results, a representative hydraulic system was investigated.

Fig. 3 shows the actual results of a system responding to a step input signal given simultaneously to two servoactuators. The characteristics of the system are: $P_0 = 3000$ psi, $V_0 = 25$ cu in., $k = 1.3$, $K = 10.6$, $\tau = 0.6$.

From Fig. 3, it's seen that the reservoir volume changed from 33 to 39 cu in. in 0.2 sec. Thus, $t_1 = 0.2$, $V_1 = 6$ cu in., and $\omega_1 = 15.7$ rad/sec. Calculating the minimum system pressure gives 2270 psi.

This result is within 2% of the data show in Fig. 3. The maximum load flow rate was calculated as 69 cu

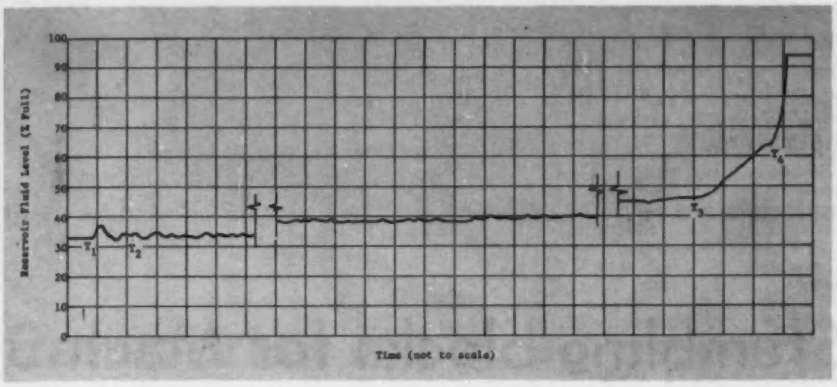


Fig. 4 — Example of telemetered reservoir level from possible missile flight. Marked points are: T_1 = hydraulic power transfer, T_2 = servoactuator motion of missle lift-off, T_3 = rocket engine cut-off and hydraulic pump rundown, and T_4 = completion of hydraulic accumulator discharge.

in./sec. This is within 5% of the flow rate computed from the measured maximum slope of the actuator displacement trace of Fig. 3.

Simulated missile flight

Fig. 4 shows how a trace of reservoir level obtained by telemetering from a hypothetical missile flight test might appear. The operation of the system may be readily analyzed from this figure.

At time T_1, the ground hydraulic power is disconnected by nitrogen-actuated disconnects, and the hydraulic system is then operating on the missile pump. A pressure transient takes place (reflected as a transient in reservoir level) as transfer is made from ground to missile pump. At lift-off (T_2), the actuators move to correct for misalignment of the engines, creating a small flow rate, which appears as motion of the reservoir piston, reflecting a pressure change and a flow rate. During flight, minor motions of the actuators create reservoir volume transients of small magnitude, and the nominal volume steadily increases as the fluid temperature rises.

At engine cut-off (T_3), the pump runs down and the accumulator discharges. Assuming a 3000-psi system pressure when the accumulator starts to discharge, the pressure at the end of accumulator discharge is readily obtained at the point where reservoir level increases sharply (T_4). This pressure change provides data on the accumulator precharge value. A rapid rise in reservoir level after the accumulator has discharged would likely occur, due to boil-off of fractions of the oil and of air in solution as the reservoir pressure falls to near zero psi absolute at altitude.

Failure analysis

A quick look at a data recording, such as that of Fig. 4, is sufficient to provide a gross picture of the performance of the hydraulic system. A similar recording, taken during ground checkout, either during a static firing or during a cold engine control system checkout, could provide sufficient information on the flight-readiness condition of the hydraulic system.

Should a nontypical reservoir level recording be obtained, a fairly rapid analysis of the trouble can be made by studying the recording. For example, during a static firing of a missile, the reservoir level might fail to take its normal thermal expansion rise. Instead, it might drop at a slow rate *after* disconnect of the ground hydraulic power. It would be immediately apparent that external seal leakage was occurring, possibly at the self-sealing disconnect nipples. Examination of the system would probably reveal disconnect seal failure or particles of contaminate under the poppet of the disconnect nipple.

During a flight, a brief period of erratic oscillation of reservoir level might be noted, although commutated recordings of actuator positions might not show unusual operation.

Gyro displacement recordings, showing missile attitude transients, would lead to the conclusion that one actuator had moved erratically. Analysis of the recording of reservoir level could then provide estimates of the velocity and displacement of this actuator during its period of motion.

Table 1 gives a summary of various other failure modes and the corresponding reservoir level indication. Another system, with different circuitry, may be expected to require a somewhat modified table of symptons and failure modes.

Table 1 — Malfunction Indications from Reservoir Volume

Reservoir Volume Indication	Malfunction Indicated
Greater than normal increase in nominal	Excessive fluid heating
Less than normal increase, or decrease, in nominal	External leakage of fluid or accumulator gas
Rapid increase and failure to return to nominal	Loss of pressure
Rapid decrease and failure to return to nominal	Sudden loss of fluid or accumulator gas
Higher than normal frequency of transients	Low accumulator charge
Lower than normal frequency of transients	Excessive air in system
Rapid decrease to less than a specified limit and return to nominal	Excessive pressure surge

Lack of data and high-temperature,

high-altitude effects on materials are . . .

Stumbling blocks for Mach 3

Based on paper by

M. G. Childers

Lockheed Aircraft Corp.

Table 1 — Materials for 400-800 F Usage

	Material Designation	Remarks
Magnesium	Magnesium-thorium Alloy	Low strength Short time at temperature
Aluminum	Aluminum powder Metals	Low strength Secondary structure only
Titanium	6Al-4V	Available
	4Al-3Mo-1V	High strength
	120 VCA Beta	Unstable above 500 F
	Commercially pure	Low strength (Expensive)
Corrosion-Resistant Steels	30301 extra full hard	Fatigue & fail-safe questionable
	AM-350	Good fail-safe High strength
	17-7 PH	High strength
	15-7 Mo	Fatigue & fail-safe questionable
	51420	
Low Alloy Steels	4340	Poor corrosion resistance Better for higher temperatures Good for welded steel tubing
	4130	
	H11	
Nickel Base	Inconel X	Too heavy for this temperature range Better for higher temperatures Expensive
	Rene 41	
	Hastelloy	
Miscellaneous	Beryllium	Expensive Difficult to fabricate Better for higher temperatures Heavy (except beryllium)
	Cobalt base alloys	
	Molybdenum	
	Vanadium	

STRUCTURAL MATERIALS for Mach 3 jet transports pose one of the toughest selection problems for the design engineer. Two of the main reasons for this problem are incomplete information on the host of possible metals and the diversity of *critical* properties that are added by supersonic requirements.

A rundown on existing and promising new metals show stainless steels and titanium as front runners, as seen in Table 1. However, beryllium may overtake them if some of its undesirable properties are suppressed.

The incomplete data problem is pointed up in Table 2 by the 37 items that would be useful in selecting the right material. Of course, this data should be available over the 400–800 F temperature range contemplated for the supersonic jet transport. An example of the emphasis on the critical nature of some metal properties is "crack propagation." Trisonic jet transports need vastly increased reliability and fail-safe characteristics, since they will be flying at roughly twice the altitude of present jet transports. This puts much greater stress on crack propagation because more time is needed to bring the aircraft to breathable altitudes if a failure starts that allows cabin pressure to drop.

To illustrate the data available, some of the more common properties of titanium and alloy steels will be discussed next.

Tensile strength

Typical data (at temperature) are shown in Figs. 1 and 2 for titanium and alloy steels. When considered on this basis alone, titanium appears to be superior. Both ultimate and yield strengths are presented.

Crack propagation

Materials that rate good in strength-weight ratio may fall down miserably in crack propagation resistance. In Figs. 3 and 4 the wide variations in crack propagation of different steels are shown. Also, titanium and aluminum are added to Fig. 4 for comparison purposes. In general, the trans-

transports

Table 2 — Data Required for Material Evaluation

Mechanical	Physical	Metallurgical	Miscellaneous
1. Tensile properties	1. Density	1. Chemical composition	1. Cost
2. Compression properties	2. Thermal conductivity	2. Heat treatment	2. Availability
3. Shear properties	3. Thermal expansion	3. Critical temperatures	3. Toxicity
4. Bearing strength	4. Specific heat	4. Ageing effects	4. Tolerance
5. Poisson's ratio	5. Emissivity	5. Spot welding	
6. Impact strength	6. Electrical resistance	6. Fusion welding	
7. Fatigue properties	7. Magnetic permeability	7. Brazing	
8. Creep in tension & compression	8. Nuclear properties	8. Corrosion & oxidation	
9. Stress rupture	9. Melting temperature	9. Stability	
10. Notch sensitivity			
11. Formability			
12. Machinability			
13. Crack propagation			
14. Hardness			
15. Thermal shock			

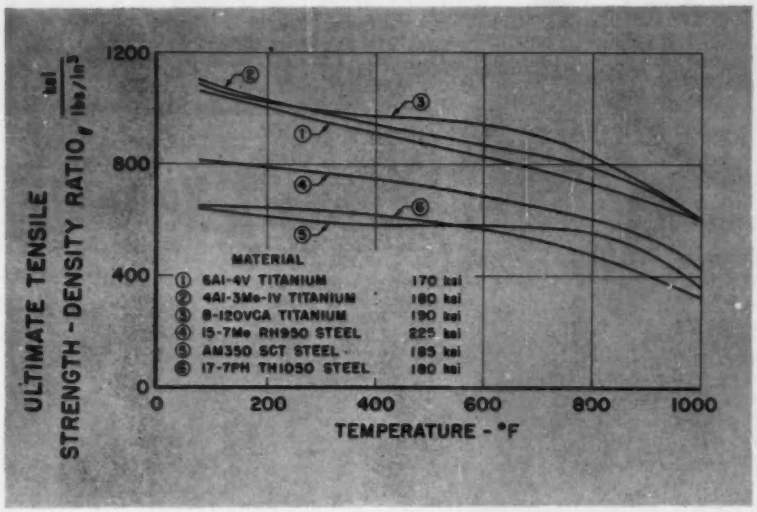


Fig. 1 — Ultimate tensile strength-density ratios for two promising materials — titanium and steel.

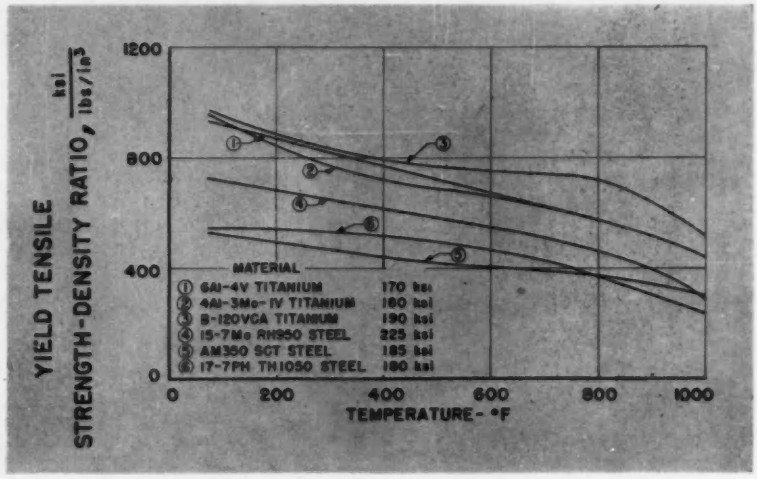


Fig. 2 — Yield tensile strength-density ratios for titanium and steel alloys.

Mach 3 Transports

. . . continued

Table 3 — Thermal Properties of Materials

Material Type	Specific Heat (C_p)	Thermal Conductivity (k)	Thermal Expansion (α_m)	Density (σ)	Modulus of Elasticity (E)	Diffusivity (α)	Thermal Stress ($\alpha_m E$)
S-S 17-7 PH	0.13	0.24	6.1	0.276	27.0	0.67	165
Ti 6Al-4V	0.14	0.12	4.8	0.163	15.0	0.53	72
Ni Inconel X	0.115	0.19	7.6	0.300	29.5	0.55	225
Be AMV — hot pressed	0.55	2.06	7.5	0.067	42.5	5.60	320
Al 2024-T4	0.22	1.82	12.5	0.100	10.0	8.30	125

verse properties of steels are only half as good as the longitudinal properties.

Another problem is the lack of standard test methods which make data difficult to compare or even unreliable.

Thermal properties

The coefficient of thermal expansion is the single most important thermal property, because it leads to the high thermal stresses under the extreme temperature gradients found in supersonic designs. Specific heat, thermal conductivity, and emissivity may be important for specific problems, but generally large variations in these properties result in relatively small differences in the thermal stress. It is desirable to have high values of thermal conductivity and emissivity and low values of specific heat for low thermal stresses.

Numerical values for these properties are shown in Table 3 for several airframe materials. The values are averages, since the properties themselves vary with temperature. From these figures it is apparent that titanium will have about half the thermal stress expected for stainless steels.

To Order Paper No. 111T . . .
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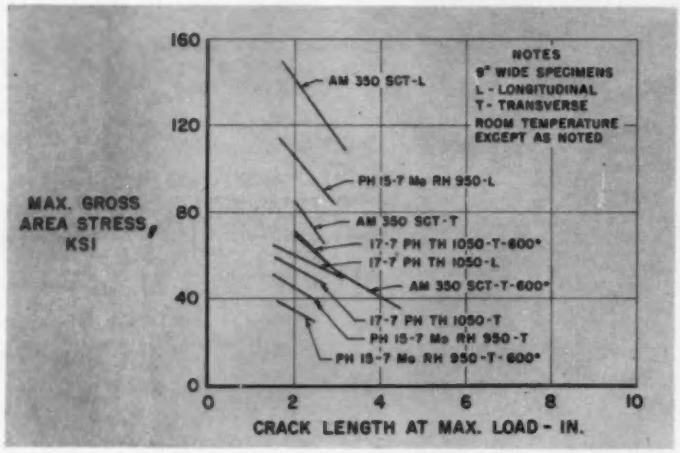


Fig. 3 — Crack tear test results are critical for the high-flying supersonic jet transport. Steel alloys are shown.

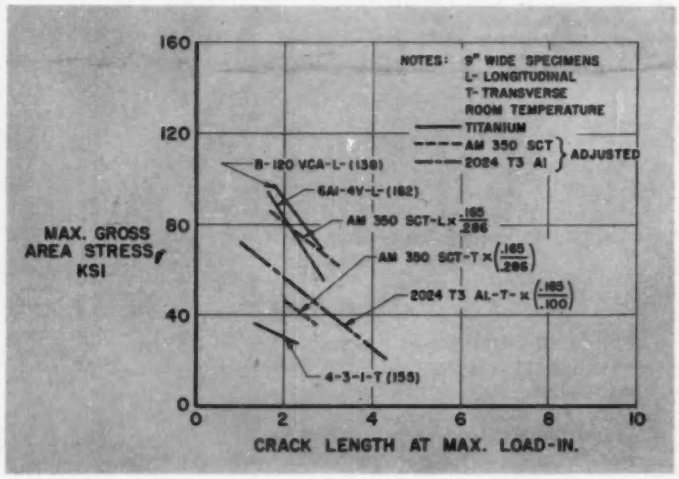
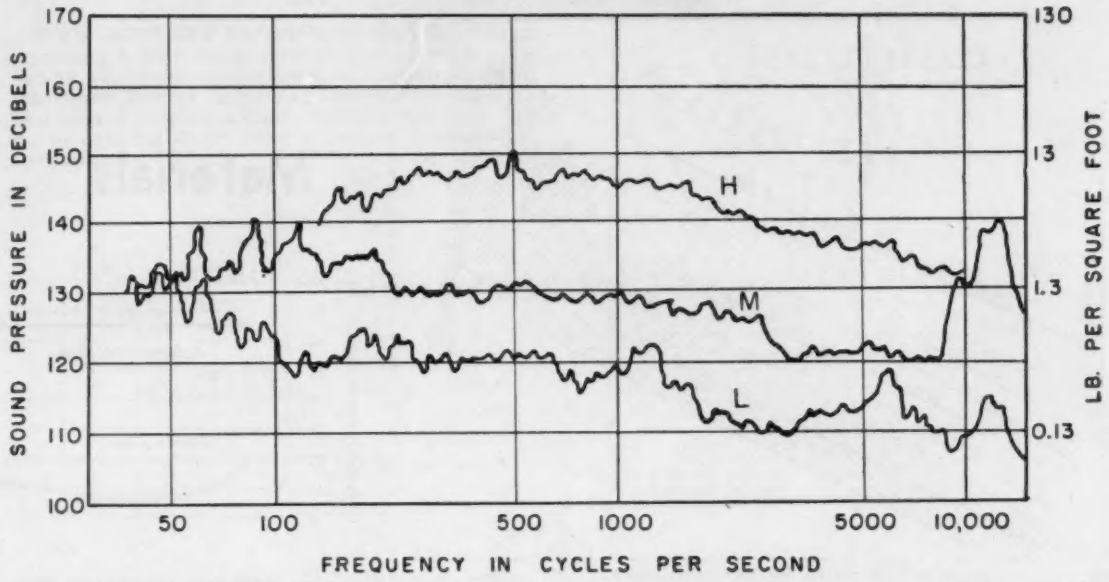


Fig. 4 — Crack tear test results for titanium alloys compare well with steel and aluminum.

The Problem



THE START OF MODERN VIBRATION PROBLEMS comes from the high level and wide band characteristics of exciting forces in modern aircraft and missiles. An example is the aerodynamic excitation that an aircraft undergoes because of jet engine noise. The three plots give typical sound pressure data for a jet engine with high (H), medium (M), and low (L) exhaust velocities.

Damping adhesives solve missile vibration problems

Based on papers by

B. J. Lazan

Head of Aeronautical Engineering Dept., University of Minnesota, and

Jerome E. Ruzicka

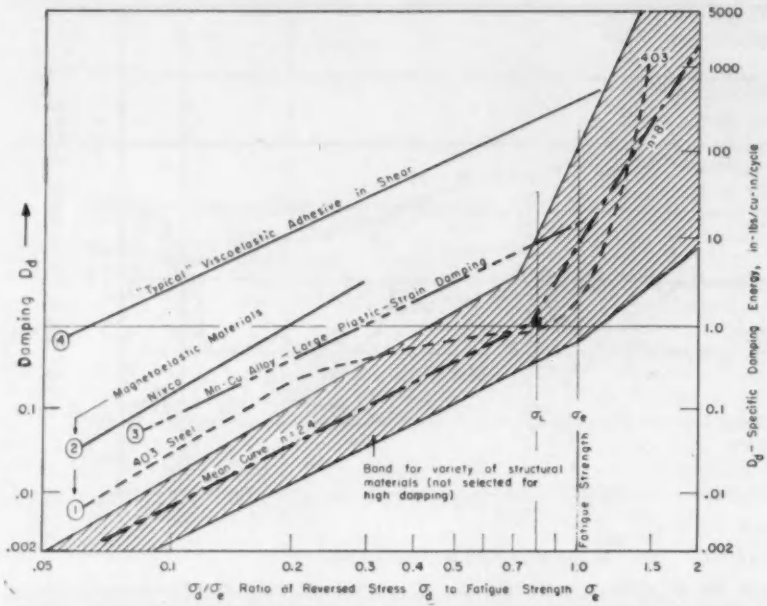
Barry Controls, Inc.

HIGH DAMPING ADHESIVES promise a solution to vibration-fatigue problems in missiles and modern jet aircraft. An adhesive's great capacity to absorb vibration energy gives the design engineer a way of protecting fragile equipment even though it is operating at or near a resonant frequency.

The vibration problem arises because modern flight vehicles are subject to increasingly wide bands of exciting forces while vehicle weight is becoming more critical. This prevents the designer from using a traditional "out" of adding weight and stiffness to the design to separate natural and exciting frequencies.

When the damping factor of a structure is increased sufficiently, then the amplification of the driving or exciting force is low enough to prevent damage to parts and keep cyclic stresses below the fatigue limit in supporting structures.

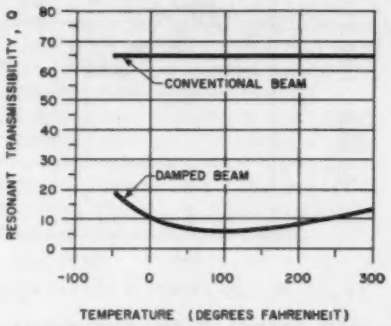
Materials . . . Designs . . . Test Results ——→



THERE IS SOME DAMPING in all structures experiencing cyclic strain. However, metals do not exhibit large damping factors until the stress level approaches the fatigue strength. Designs using the right-hand part of the curve would have limited life. Adhesives in shear have high damping ability, note the logarithmic scale. Furthermore, they have linear characteristics that make them easy to use in calculations.

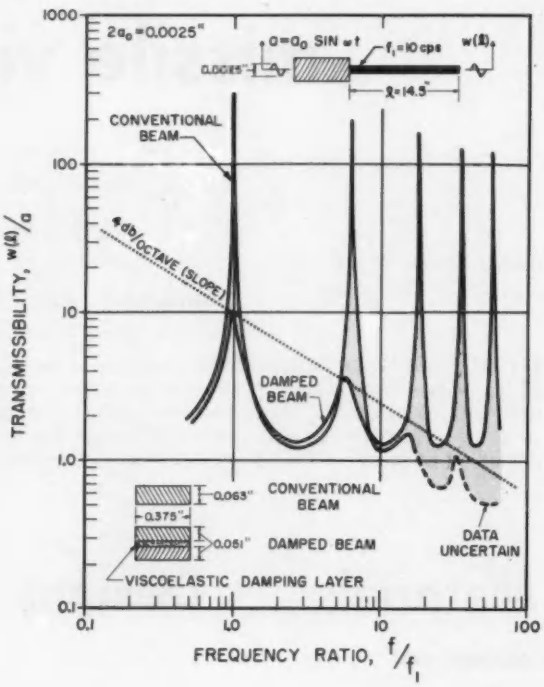
A further advantage of adhesive damping is that the damping energy is absorbed in the *volume* of the material rather than at the surfaces only, as in the case of sliding friction used for damping. This also means that there is no surface deterioration due to fretting since the surfaces of attached parts are bonded together by the very nature of the adhesive.

Materials



TEMPERATURE does have an effect on adhesive damping characteristics while metals are unaffected in conventional temperature ranges. The data are for the clamp-free aluminum beam of sandwich construction (see Test Results Section.) The change in natural frequency results from a tendency of the adhesive to freeze at low temperatures, thereby producing a high damping coefficient and a high resonant frequency.

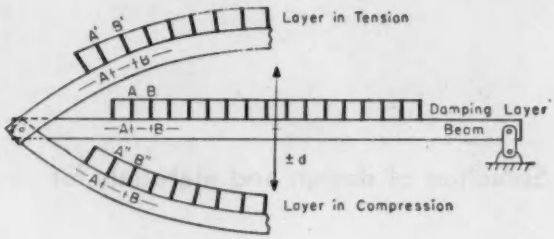
Test Results

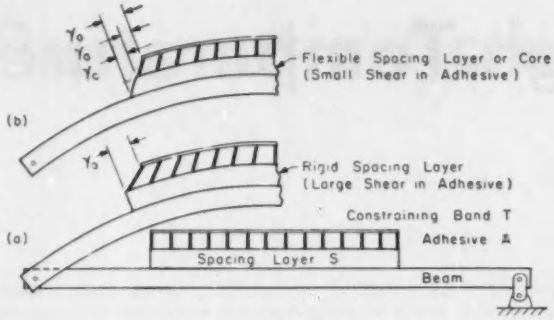


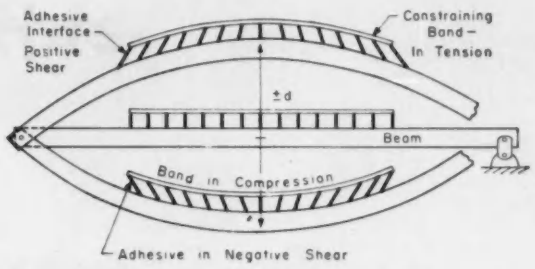
COMPARISON OF A CONVENTIONAL AND A DAMPED ALUMINUM BEAM shows a marked decrease in transmissibility (or amplification factor) for the damped beam. The cross-sections of the two beams are designed to produce the same static stiffness. This is done by making twice the cube of the damped beam laminate thickness equal to the cube of the conventional beam thickness. The length and width of both beams are the same. The fundamental resonance of both beams is 10 cps. Frequency is plotted as a ratio of exciting frequency to 10 cps.

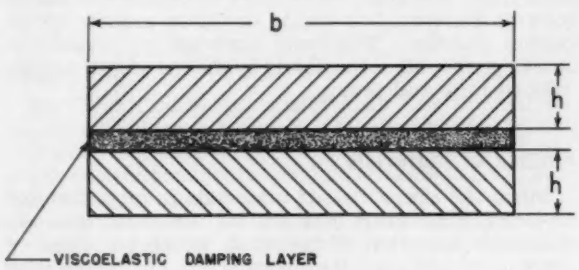
Designs

GOOD ADHESIVE DAMPING DESIGN depends on producing a high shear level in the adhesive. The variety of designs shown indicates that constraining bands and spacing layers can improve the damping of a beam if properly applied. These designs are typical of damping added after a part or structure has been frozen in design.

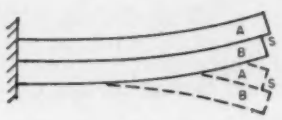


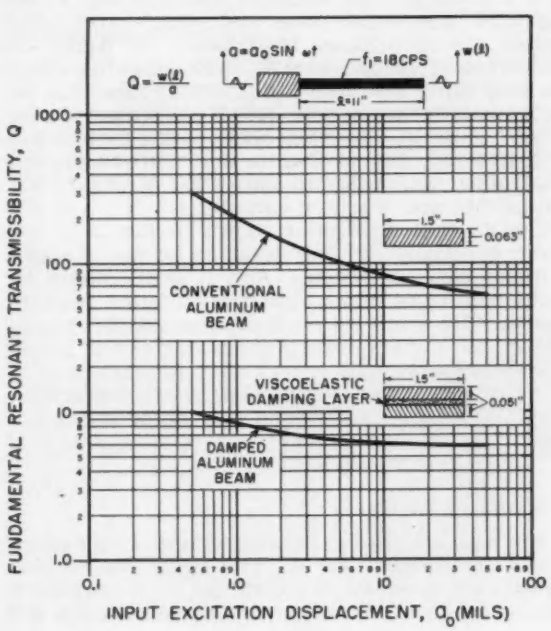






A THIN LAYER OF ADHESIVE acts to form a sandwich of two metal strips. When the beam flexes, the relatively thin adhesive layer can be put under high shear stress, especially at the free end. This design was used for the test cases shown below.





A SECOND WAY OF DEMONSTRATING THE EFFECT OF DAMPED BEAMS is to vibrate the beam at its natural frequency and vary the input excitation level. Again, the damped beam shows a much lower transmissibility. This test plus one on a beam clamped at both ends shows a fairly constant transmissibility. This fact will simplify analytical calculations. The metal used for the beam is 5052-H32 aluminum.

To Order Papers No. 100U and 100Y . . .
. . . on which this article is based, turn to page 6.

Selection of design and materials for . . .

High-Temperature

Based on paper by

W. J. Koerner

Marquardt Corp.

THE ability of pneumatic actuation systems to operate at extremes of temperature makes them highly attractive, especially since elevated temperature requirements are fast outstripping the state-of-the-art advances in hydraulics.

Evaluation of several types of air motors indicates that one based on the principle of the nutating disc appears most promising for a high-temperature system. The absence of complex valving in this type assures high reliability.

Principle of operation

The nutating disc principle is exemplified in the common domestic water flowmeter. The movable element in this type of motor is a flat disc attached to a central sphere and mounted in an annular chamber, which has a spherical sidewall bounded by conical upper and lower surfaces. The plate is prevented from rotating about its own axis such that when subjected to a differential pressure, a nutating motion is executed. Rotary power is obtained by means of a Z crank. The rotary motion of the motor may be converted to linear or other motion by an output linkage. The most common conversion to linear push-pull actuation is by means of ball screw-jack or rack and pinion.

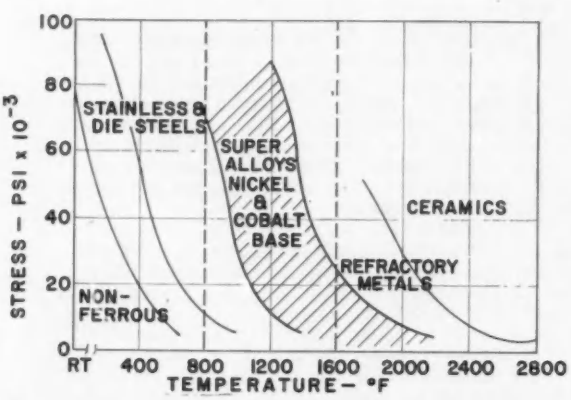


Fig. 1 — Material to use in air motors for service at 1200 F is indicated by relating its usability to temperature range, based on 1000-hr rupture stress.

Choice of materials

Since the properties of materials in an air motor are changing while the service temperatures are changing, selection of materials which will operate efficiently over the entire temperature envelope is of paramount importance.

Material usability versus temperature range, based on a 1000-hr rupture stress, is shown in Fig. 1. As indicated, the cobalt base and other super alloy metals are of primary importance for design at temperatures around 1200 F. The following alloys are now being used successfully in applications for continuous operation with 1200 F gas temperatures: A-286 (equivalent to AMS 5736), S-816 (equivalent to AMS 5765), Haynes Stellite Nos. 3, 16, 19, 6B and No. 25 Alloy (equivalent to AMS-5759), M-252, J-1570, Udimet 500 and titanium carbide.

The air motor actuator shown in Fig. 2 is now under development. It is designed for use in a 1200 F direct ram air system. And it is adaptable for flight control or other airborne actuation requirements. The prime mover is an opposed pair of nutating disc motors operating 180 deg out of phase. The mechanical ratio is such that for each inch of actuator rack travel, the motors rotate five revolutions. The materials used in this motor are as follows:

Antifriction bearings

The need was for a material with good hot hardness retention at 1200 F. The Hertz compressive stresses are in excess of 200,000 psi for a reasonable size of bearing. Available hot hardness data and

Pneumatic Actuators

room temperature properties directed the use of Haynes Stellite No. 3 for both the bearing races and rolling members, despite its slightly lower hardness at 1200 F than some of its sister alloys.

Gears

High gear tooth loads and gear size limitations necessitate Hertz compressive stresses of 200,000 psi and tooth-bending stresses of 50,000–60,000 psi. This requires a material with good hot hardness retention but with greater ductility than Haynes No. 3, particularly because of an imposed 10*g* vibrational load. The best available material is Haynes Stellite 6B, which is a wrought, cobalt-base material with compatible expansion characteristics.

Housing and Structures

The air motor housing, crankshaft, and most of the structural parts of the machine were made of alloy S-816. It is available in cast and wrought form and has good strength properties at 1200 F. Its thermal expansion is compatible with Haynes Stellite No. 3. S-816 is machineable with new techniques.

Lubrication

No lubrication system is provided since no proven method was available. Recent work shows the possibility of several solids and gases having beneficial lubricating properties at temperatures above 1000 F.

Testing

The unit was tested in a hot box with both environment and driving air at 1200 F. The rack was removed and steady-state output torque at rated speed was reacted and measured through a dynamometer attached to the last gear stage shaft. It was then run for several hours at temperatures in excess of 1200 F.

Post test inspection revealed no galling and only minor wear at points of high rubbing velocity. The gear teeth wear was not measurable. Bearing balls and races were highly polished with an infinitesimal reduction in ball diameter. All points of wear presented a polished, shiny surface as opposed to the heavily oxidized surfaces of the nonwearing portions. Evidently, the oxide coating had been furnishing an excellent high-temperature lubricant, which replaced itself as it was used.

To Order Paper No. 107U . . .
. . . on which this article is based, turn to page 6.

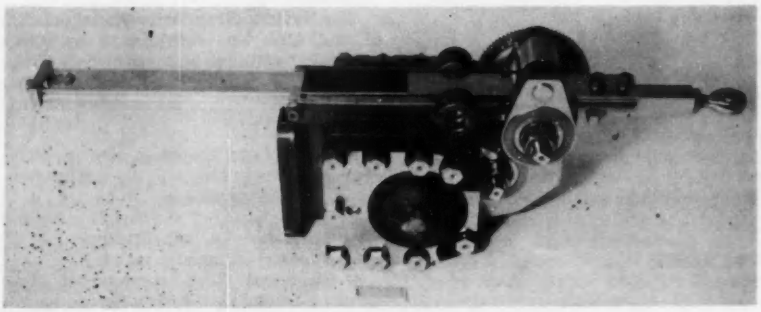
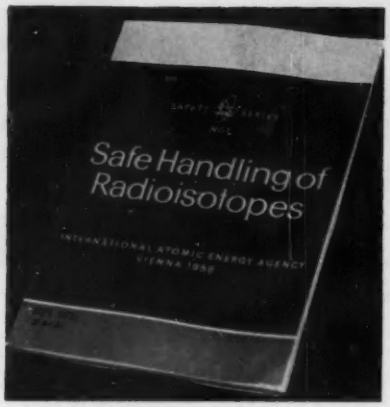


Fig. 2 — Air motor actuator designed for use in a 1200 F direct ram air system. The prime mover is an opposed pair of nutating disc motors operating 180 deg out of phase.

Many Groups Developing Atomic Energy Standards



A report of the SAE Nuclear Energy Advisory Committee

C. R. Russell, GM Research Laboratories

. . . Dr. Russell is the SAE representative to the Nuclear Standards Board of the American Standards Association, and is chairman of an ASA subcommittee, N5.4 — "Use and Handling of Radioisotopes and High Energy Radiation."

A VARIETY of organizations, including a number of governmental agencies, are participating in the preparation of standards and safety regulations for the atomic energy industry. Here's a list of some of them, with an indication of their areas of responsibility.

U. S. Government Agencies

The U. S. Atomic Energy Commission establishes regulations for protection against radiation hazards arising out of activities under licenses issued by the AEC. The uses of natural radioactive materials such as radium or other sources of radiation (X-ray machines) not licensed by the Commission are not subject to their regulations. The AEC regulations are published as Title 10 of the Code of Federal Regulations. Many states have issued regulations governing the use of radioactive isotopes, X-radiation, and all other forms of ionizing radiations. These regulations are similar to the AEC regulations.

The National Bureau of Standards has statutory responsibiilty to cooperate with other government agencies and with private organizations in the development of standard practices, incorporated into codes and specifications for the safe use of ionizing radiation. These usually take the form of recommendations prepared by the NBS-sponsored National Committee on Radiation Protection and Measurements (NCRP). Such recommendations are usually published as handbooks, of which NBS Handbook 69, "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupation Exposure," is typical and the most recent. The National Bureau of Standards publication, Handbook 66, "Safe Design and Use of Industrial Beta-Ray Sources," was prepared by an American Standards Association Sectional Committee and adopted as an American Standard. Standard samples of radionuclides are also prepared and distributed by the Bureau for use in calibrating instruments and for comparison with other samples. Such standard samples are exchanged between countries for international intercomparisons, the results of which have, in recent years, been collated by the Committee on Standards and Measurements of Radioactivity for Radiological Use which is a committee of the International Commission on Radiological Units and Measurements.

The U. S. Public Health Service has broad responsibilities in all fields of health, which, although not specifically mentioned, includes radiological health. Two special health laws provided as supplements to the Public Health Service Act permit special activities in the radiological health field. Under the Federal Water Pollution Control Act the Surgeon General is, among other things, authorized to take measures with the cooperation of state authorities for the enforcement of the abatement of interstate water pollution, including pollution caused by radioactive materials. The second law is the Air Pollution Research and Technical Assistance Act, which provides that air pollution caused by radioactive material is within the scope of the Surgeon General's authority under this act. Under these special health laws and the Public Health Service Act, guidance and assistance is provided the states with respect to contamination by and biological effects from radiation sources.

In August, 1959, a Federal Radiation Council was established by Executive Order. Members of the Council are the Secretary of Health, Education, and Welfare; the Chairman of the Atomic Energy Commission; the Secretary of Defense, and the Secretary of Commerce. The President's Special Assistant for Science and Technology wil participate as an adviser in the discussions of the Council, which will advise the President and further interagency coordination of measures for protection against radiation.

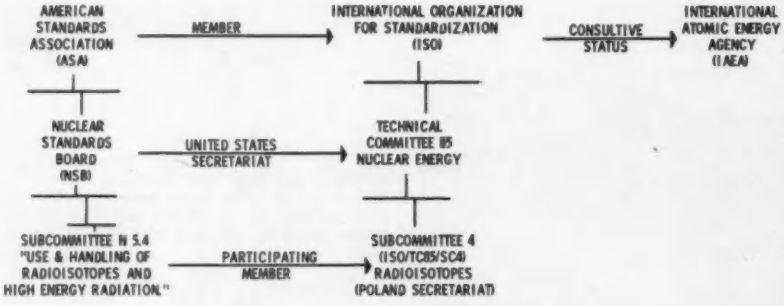


Fig. 1 — Relations between organizations.

Industrial Standards

Industrial standards specifying accepted good practice in procedures, composition of matter, design methods, arrangements, symbols, organization, performance, and inspection will be provided in this country through the American Standards Association.

The Nuclear Standards Board (NSB) of the ASA was established in 1956. Several technical societies, including the SAE, participate actively in this work. Committees under this Board are as follows:

1. Glossary of Terms in Nuclear Science and Technology (This committee has been terminated).
2. General and Administrative Standards for Nuclear Energy.
3. Nuclear Instrumentation.
4. Electrical Requirements for Reactors and Nuclear Power Systems and

Generation and Application of Nuclear Radiation.

5. Chemical Engineering for the Nuclear Field.
6. Reactor Safety Standards.
7. Radiation Protection.

There are several projects under each of these committees.

International Organizations

The International Labor Organization (ILO) is an official international institution, operating in the sphere of the United Nations, that establishes international labor standards. In 1949, a collection of standards on protection against ionizing radiation was published and embodied in their "Model Code of Safety Regulations for Industrial Establishments for the Guidance of Government and Industry." These provisions have since been revised and handbooks are being prepared to guide industry in the use of ionizing radiation. A manual of "Industrial Radiation Protection, Part II, Model Code of Safety Regulations (Ionizing Radiation)" was recently published by the International Labor Office in Geneva.

The International Organization for Standardization (ISO) was founded in 1946 as an outgrowth of the United Nations Standards Coordinating Committee, which undertook to standardize arms and equipment used by the Allies during World War II. Prior to this, the International Federation of National Standardizing Associations (founded in 1926) was the international standards body, but became inoperative during the early years of the war. As now constituted, the ISO has about 40 member nations. The American Standards Association is the United States member. Technical work of ISO is carried on by technical committees made up of a delegation from each of the member bodies wishing to take part in the work of the committee. Each project has as a secretariat a member body named by the ISO Council.

An international project on nuclear standards was established under the ISO and the first meeting of the responsible Technical Committee was held in Geneva in 1957. The United States holds the secretariat for this committee (ISO/TC185), which has the following subcommittees:

1. Terminology, Definitions, Units, and Symbols (Secretariat, USA).
2. Radiation Protection (Secretariat, France).
3. Reactor Safety (Secretariat, United Kingdom).
4. Radioisotopes (Secretariat, Poland).

The International Atomic Energy Agency (IAEA), which began functioning in October, 1957, under Statute adopted by the United Nations, is empowered to provide for the application of standards of safety for protection against radiation to its own operations, and to operations making use of assistance provided by it or with which it is directly associated. The first publication in their safety series is, "Safe Handling of Radioisotopes," shown above. The IAEA has given consultive status to the International Organization for Standardization through their Technical Committee 85, Nuclear Energy, and they are invited to send representatives to conferences, such as the September conference in Warsaw, on "Application of Large Radiation Sources in Industry." Also, there is an informal agreement, which was reached at the Harrogate, England meeting of ISO Technical Committee 85, under which the IAEA will promulgate codes of practice and the ISO will consider adoption of parts of these codes in the ISO standards. Some of these interrelations are indicated in Fig. 1.

Under the several national and international committees there are many groups at work on specific standard projects. Perhaps a typical example is Subcommittee N5.4, "Use and Handling of Radioisotopes and High Energy Radiation," under the NSB. This group has four active standard projects and in addition represents the USA in ISO/TC85 Subcommittee 4. A delegation was provided representing this country at the meeting in Poland on April 21–22, 1959. Delegations from 11 nations attended this meeting, which was notable for the cooperative attitude of the representatives and the efficiency with which the official busines was handled. Specific responsibilities were assigned, with the U. S. delegation accepting the secretariat of a working group on standards for unsealed radioisotopes radiation sources. In addition to the official business, the delegates were taken on tours of nuclear installations, including the research reactor at Swierk near Warsaw and other places of interest. (Dr. Russell is SAE representative to the Nuclear Standards Board of ASA; and is chairman of ASA Subcommittee N5.4 "Use and Handling of Radioisotopes and High Energy Radiation.")

Exhaust Brakes Can Cut Maintenance

Based on paper by

BERNT JOHNSON
Power Brake Equipment Co.

THE efficiency of a compression brake is governed by (A) engine displacement, (B) engine design, and (C) engine condition.

Generally speaking, the larger the cubic displacement of the engine the greater the retarding efficiency.

Among design factors, valve overlap is important. As overlap increases, compression brake efficiency will decrease in direct ratio. Maximum exhaust or discharge pressure cannot be attained if the intake valve opens too soon because some of the pressure will be lost to atmosphere through the intake system.

Exhaust valve spring tension is also important. The spring governs the maximum pressure that can be attained in the exhaust system with the compression brake applied. Any time the pressure is greater than preload exhaust valve spring tension, in relation to the exhaust valve area on the stem side, the exhaust valve will open on a cylinder that is on the intake stroke, relieve excess pressure and maintain a governed exhaust pressure. Thus there is an unloader and a governor for each cylinder. The only time the exhaust valve and exhaust valve spring will not function as an unloader and governor is when the valve overlap is so great that pressure in the exhaust manifold cannot overcome the valve preload tension.

When the exhaust stroke is turned into a compression stroke, the engine becomes an air compressor and gross vehicle weight becomes the motive force driving the engine-turned compressor. And the retarding effort can be increased or decreased by the transmission gears, or by the compression brake application valve, which regulates the butterfly opening to control compression brake retarding effort.

To Order Paper No. 88W . . . on which this article is based, see p. 6.

Turbocharger Excels In High-Altitude Work

Based on talk by

R. C. KEAST
Canadian Kenworth, Ltd.

ONE outstanding characteristic of the turbocharger is its inherent high-altitude performance. It affords sea-level ratings in engines operating at 12,000–14,000 ft above sea level.

One reason for failure in the early days of high-altitude operation was because no fuel flow control valve was used and fuel rack settings were not modified.

The basic advantage of the turbocharger in any application is that of increasing horsepower when and where it is required, but there are also lesser advantages. The exhaust is quieter due to the breaking up of exhaust pulsations in passing through the turbine. In many cases, the muffler can be eliminated. Some users claim the turbocharger to be an excellent spark arrestor for use in the woods on off-highway vehicles.

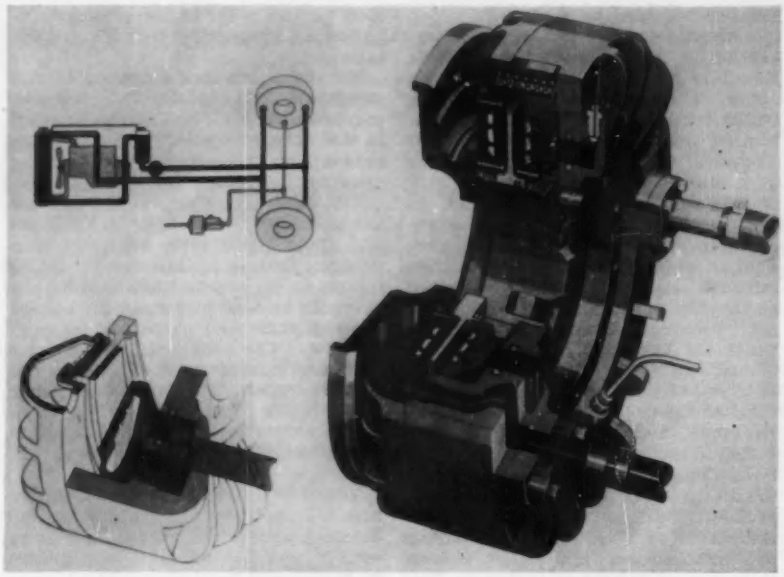


Fig. 1 — Details of liquid-cooled disc brake and retarder developed by Wagner Electric for trucks and off-highway vehicles.

Liquid-Cooled Brake for Commercial Vehicles

Based on paper by

J. D. DUDLEY

Wagner Electric Corp.

A LIQUID-COOLED, disc brake for trucks and off-highway vehicles has been developed and tested by Wagner Electric (Fig. 1). The cast aluminum caliper consists of the outer and inner housing. The annular actuating piston, also of aluminum, is sealed by O-ring piston seals. The lining carrier is steel, with the lining bonded to both surfaces. The inner periphery is slotted to mate with the teeth on the driver, which is made of steel and bolted on the wheel instead of a drum. An O-ring on the carrier prevents any noise between the lining carrier and driver, and serves as a centralizer for both.

The copper friction plates are riveted to the outer housing and the copper carrier and sealed with O-rings. The inner copper carrier and the actuating piston are separated so that the brake can be disassembled and the lining replaced without disturbing the hydraulic side of the brake. Liquid can enter either side, depending on the axle mounting, and flow through the coolant passages to the back side of the copper friction plates. To promote heat transfer through the copper, the back side has grooves cut to double the area. The brake is protected from road splash and dirt and contains no running seals.

An off-highway version of this brake has been developed that employs double discs (four lining faces) instead of two, and has an opposed piston type of actuation with larger overall diameter.

The engine cooling system provides the brake coolant. Using the coolant common to both the brake and the engine cooling system (specific heat of ethylene glycol 5.68 times that of iron and water 7.2 times that of iron) adds to the total heat sink that must be accounted for in conventional-type drum brakes to dissipate the same amount of heat.

Control of the disc brakes, as well as the conventional drum brakes on other axles, is through the conventional treadle valve. When the driver wishes to retard the vehicle he puts the selector valve in the retarding position, which puts the retarding valve in the system. When the selector valve is in service position, the retarder valve is cut out and the disc brakes act as service brakes, taking an equal portion of the load.

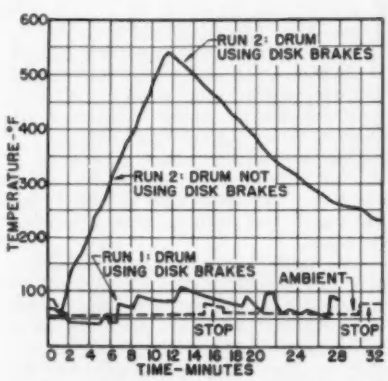


Fig. 2 — Performance of Wagner liquid-cooled brakes compared with that of conventional drum brakes on test runs in direct drive descent of Berthoud Pass (Colorado) at 35 mph with tractor-semi-trailer combination having a gvw of 60,000 lb.

Brake Performance Under Test

Fig. 2 shows the performance of the liquid-cooled brakes on descending Berthoud Pass in Colorado, which has grades of 4–6% for 13 miles. The pass was descended in direct drive at 35 mph except on sharp curves.

On the first run, using only the two disc brakes, the drum temperature of the service brakes maintained an average 75 F, or only 20 F above ambient. Stops were made at 9.4 and 17.5 miles, the first stop being made to show that the tractor-semi-trailer combination could be brought to a controlled stop on the grade.

The second run followed a similar procedure except that the disc brakes were shut off to allow use of only the eight conventional air brakes. Drum temperature rose to 540 F at 6.7 miles from the summit, so the drum brakes were released and the two disc brakes brought in for the rest of the run. The drop in temperature of the drums, which began almost immediately on release of the drum brakes and use of disc brakes, is clearly shown in Fig. 2.

The vehicle used for these tests was a combination tandem-axle tractor and tandem-axle semi-trailer, carrying a gvw of 60,000 lb.

To Order Paper No. 88U . . . on which this article is based, see p. 6.

Ways to Cut Weight Of Missile Structures

Based on paper by

R. H. LOUGHRAN
and
L. A. NELSON

Hughes Aircraft Co.

PERFORMANCE of short-flight missiles can be improved by:

- Insulating structures.
- Using plastics.

The air-launched missile, because of its short flight cycle, is in an advantageous position to use its heat capacity, thermal conductivity, and the time lag to temperature associated with transient heating to maintain its load-carrying structural temperatures below an allowable level. This time lag to

temperature can be augmented by the provision of external insulation.

Calculations have been made for estimating the weight savings associated with external insulation as compared with thickening the brazed honeycomb sandwich skin of a missile. This particular missile skin without heat protection or thickening provided marginally allowable temperature at the skinbraze interface. It was found that thickening the skin to provide an allowable temperature would give a weight aproximatelly 50% more than providing it with sufficient external insulation to provide the same time lag to temperature.

Because of the short exposure to extreme temperatures, filament-wound, glass-reinforced plastic appears to be more efficient in the strength/weight relationship than either steel or magnesium in a particular missile application. This can be explained in part by the relative thermal conductivities of the materials. Metals will approach equilibrium temperatures. In the case of reinforced plastics, the conductivity is so low and the thermal exposure is so short that only the outermost fibers approach equilibrium temperatures.

To Order Paper No. 106U . . . on which this article is based, see p. 6.

Aircraft Success Hinges on Basic Design

Based on paper by

A. B. CROSHERE, JR.
Douglas Aircraft Co., Inc.

TAKE-OFF weight reveals a most important characteristic of the successful aircraft (Fig. 1). It is an index of growth because it is one of the ways that a design is exploited to carry more payload over longer segment lengths. In other words, successful aircraft are developed over a long period of time, usually well after they have left the preliminary design section. This is a sobering fact to an advance design engineer.

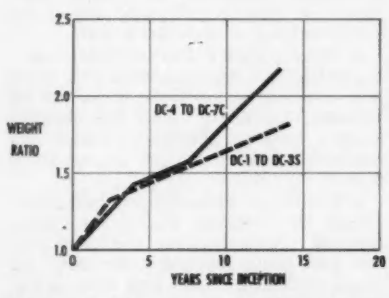


Fig. 1 — Exploiting an established aircraft design. Good initial design is a necessary but insufficient condition for an outstanding aircraft.

This fact brings home two points. First, a successful design family is possible only if the initial design has an inherent arrangement which lends itself readily to practical and useful growth. Second, the role of design development is never really finished but must be exercised diligently if the design potential of a new aircraft is to be realized during the life of the project.

Excellent detail engineering and top-flight production design will create a world-beating aircraft if the initial preliminary design has been properly conducted, but all the king's dollars and all the world's engineers cannot salvage a poor conception. Good initial design is a necessary but insufficient condition for an outstanding aircraft.

To Order Paper No. S204 . . . on which this article is based, see p. 6.

Jet Ground Needs Being Met Rapidly

Based on paper by

GORDON W. McKENZIE
Trans. World Airlines, Inc.

COMMERCIAL ground support equipment is expanding to meet jet transport needs. Aircraft designs have been so coordinated that ground handling techniques and support equipment have been standardized for TWA's three types of jets.

A non-self-sufficient engine starting system was selected for all domestically operated airplanes after much study. This decision was made because of the high installation cost and high weight penalty of the self-sufficient system. Moreover, the self-sufficient system is more vulnerable to flight delays than one dependent on ground starting equipment.

The objective has been to keep everything required for ground support on the ground and avoid penalizing the airplanes with installed weight required for equipment needed only on the ground. This results in better ground service because more substantial, industrial-type equipment can be used without consideration of weight or size.

Ground Electrical Power

For routine, terminal operation, we selected a 140 kva-400-cps a-c truck-mounted, diesel-driven unit for ground operation of airborne electric freon air conditioning packages. The diesel prime mover is most economical and the truck mounting is feasible and economical in this size. Experience has been excellent with the 20 units in operation. Tow vehicles are equipped with a 37.5-kva 400-cps a-c power unit to furnish power during towing. Electrical facilities are considered desirable and justifiable at major stations. However, since much portable, self-propelled equipment will have been purchased to support operations at temporary terminal areas, it may prove uneconomical to duplicate this capability by the installation of fixed facilities in certain new terminal areas.

Both gas turbines and stored-air-bottle carts are being used for engine starting. Five gas turbines are used at major stations and 15 stored-air-intermittent-duty-bottle carts at low-frequency stations. Heater failures plagued early use of the bottle cart but this is being corrected by changing from a gas fired heater to an electric one.

Objectives of the ground support program have been to:

1. Provide reliable aircraft systems consistent with the economics and feasibility of related support requirements and planning.
2. Provide identical service provisions on all new aircraft so that ground equipment can be used interchangeably on all aircraft without rework, adjustment, or use of adapters.

To Order Paper No. 109U . . . on which this article is based, see p. 6.

Licks Noise Menace In Missile Checkout

Based on paper by

E. B. PRICE
North American Aviation, Inc.

SIMULATORS have been developed for missile electro-explosive devices so that the control circuitry can be checked out without danger to personnel or equipment. Devices such as explosive bolts, destruct packages, and thrusters can be energized accidentally by stray voltages (noise).

The portion of the simulator which checks for proper circuit operation presented no particular problems, but the portion that monitors the circuit for noise was difficult to develop because of some of the properties of noise. Noise pickup is dependent upon the impedance of the circuit. The electro-explosive devices have impedancies in the 0.1–0.2 ohms range. Noise also exists at any and all frequencies in a very

How to Check the Performance of a Hydraulic Retarder

Excerpts from a paper by

EDWARD J. HERBENAR
Thompson Products Michigan Division,
Thompson Ramo Wooldridge, Inc.

THREE simple steps are all that are needed to check if service brakes must be touched when going down a grade, the manufacturers of Thompson hydraulic retarders say.

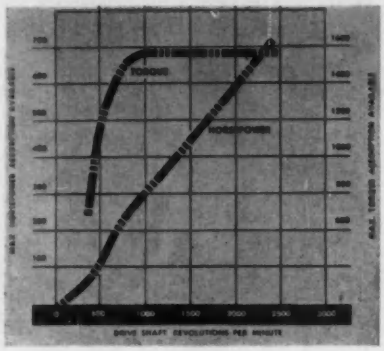
First, the speed of the driveshaft must be calculated; second, the braking horsepower needed to hold a given weight vehicle at a fixed speed down the grade is calculated; and last, the needed horsepower is checked on the chart shown below to see if it is available from the retarder.

The drive shaft speed is found from:

$$\left(\begin{matrix}\text{Driveshaft}\\ \text{speed, rpm}\end{matrix}\right) = \frac{\text{Desired vehicle speed, mph} \times \text{axle ratio} \times 168}{\text{Tire rolling radius, in.}}$$

The horsepower required to keep the vehicle at the desired speed down the grade comes from:

$$\left(\begin{matrix}\text{Braking horsepower}\\ \text{needed}\end{matrix}\right) = \frac{\left(\begin{matrix}\text{Desired}\\ \text{vehicle}\\ \text{speed,}\\ \text{mph}\end{matrix}\right) \times \left(\begin{matrix}\text{Vehicle}\\ \text{gross}\\ \text{weight,}\\ \text{lb}\end{matrix}\right) \times \left(\begin{matrix}\text{\% of}\\ \text{grade}\\ -1.5\%\end{matrix}\right)}{375}$$



Using the shaft speed found from the first equation, use the chart to find the retarding horsepower available from the hydraulic retarder. If it is greater than the horsepower found from the second equation, service brakes are not needed.

Two limiting points must also be considered; the radiator of the vehicle must be able to dissipate the heat (horsepower) generated by the retarder, and an 80-psi air supply must be available to actuate the retarder.

To Order Paper No. 88V . . . on which this article is based, see p. 6.

broad range (from d-c to rf of thousands of megacycles).

An ingenious combination of existing unrelated elements provided a solution. The squib wire from the electroexplosive device was placed in an evacuated capsule with an infrared, 4-leg, bolometer bridge. All noise reaching the squib wire is dissipated as heat, thus producing infrared radiations. Opposite legs of the bolometer bridge are exposed to these radiations, thus unbalancing the bridge. Since the bolometer bridge is excited with an external power source, the output signal from the unbalanced bridge exceeds that of a self-generating thermocouple. This now becomes a very usable signal. It is used to actuate audible and visual indicators signifying that dangerous noise levels exist in the circuit which may detonate the electro-explosive device when installed. Thus, corrective action can be initiated to avert a possible accident.

Objectionable noise-producing items of high sound level are present in two main areas of weapon system 131B. These are in the missile runup building. The major source of noise in the missile bay is caused by the operation of the turbojet engine. Exhaust was the principal offender so a sound-abatement chamber was procured. The other major source was high-speed rotating machinery in the control room, the offender being the hydraulic servicing unit which uses an electric motor-driven pump as the main source of hydraulic power. Here, the most feasible solution was to obtain a pump that actually produced less overall noise.

The module system is used with each module capable of quick replacement in weapon system 131B, but detailed information is available only on the explosive bolt problem.

To Order Paper No. 97T . . . on which this article is based, see p. 6.

How Often Should Engine Oil Be Drained

Based on talk by

D. C. Bardy
Lubrizol Corp.

(Presented before SAE Baltimore Section)

A 56,000-mile cab fleet test, designed to show the relationship between crankcase oil drain period and engine varnish, sludge, rust, and wear, revealed the following trends:

- There is a definite increase in engine cleanliness with decreasing oil change interval. Appreciable quantities of sludge and varnish were found in all cabs, even when the oil drain period was 1500 miles and even with the highest level of detergency. The data suggest that considerable advantage would be gained as regards deposition of sludge and varnish by reducing the drain period below 1500 miles. Further information obtained with shorter drain periods would help establish the optimum as applied to engine varnish and sludge.
- Increasing oil detergency was much more effective in increasing engine cleanliness with the 1500-mile drain than at 6000 miles. With the 6000-mile drain the ability of the detergent to prevent sludge was almost completely lost and the results were very similar to those with no detergent at all.
- The use of bypass oil filters decreased engine sludge deposition, particularly with the longer drain periods, where the detergency of the oil was depleted. The effects of filters in reducing sludge were negligible with oils which, because of superior dispersancy, permitted practically no sludge deposition. The improvement due to filtration increased as the effectiveness of the detergent was reduced and was greatest when no detergent was present. Filtration had practically no effect on varnish formation as affected by oil drain period.
- The Supplement 1 level of detergency practically eliminated tappet rust with the short drains and permitted only a slight increase in rusting when the drain was extended to 6000 miles. Tappet rust with the nondetergent oil was severe with all oil drains. Oil filtration had practically no effect on engine rusting except with the 6000-mile drains, where the filter appeared to be of some benefit.
- Increasing the oil drain period showed practically no effect on wear of the second compression ring. It caused a slight but definite decrease in the combined weight loss of connecting rod and main bearings. The reason for this effect is not established; but in evaluating its importance in engine operation, it should be remembered that wear was not great with any of the combinations of variables tested.
- The decrease in rod and main bearing weight loss with increasing oil drain period was most pronounced for the oil without detergent. With the Supplement 1 level of detergency there was practically no effect due to oil drain period.
- The use of bypass filters had practically no effect on piston ring wear, but did slightly reduce the combined rod and main bearing wear with oil drain periods of 3000 and 6000 miles. With the 1500-mile oil drain period the improvement due to filtration was

continued on p. 118

SAE NEWS

Authors Urged to Talk Problems and Solutions

"PAPERS PRESENTED TO SAE should discuss the problems faced, and the solutions used. There should be particular emphasis on progress into new areas of knowledge." That's the essence of what the SAE Passenger Car Activty wants to get across to every author invited to present a paper at the 1960 National Automobile Meeting in Detroit next March.

This Activity has taken an unusual number of specific, practical steps in the last 12 months looking toward improvement in the quality of SAE technical papers. Its latest action is to use session chairmen as a means of getting a practical, usable definition of "quality" to authors at the time they are invited.

"We are a Society of **engineers**" . . ., begins one paragraph of the Activity's

by

John S. Wintringham
Passenger Car Activity Committee

recent letter to the men selected to chairman sessions at the Meeting next March. Then the note goes on to explain the emphasis on the word **engineer.** It reads in part:

"We are a Society of **engineers,** and it is reasonable to assume that our interests will be held most strongly by meetings in which the presentations and discussions are in the same form in which one engineer would normally communicate with another in his own place of work.

"We want to know as much about the how and why as we do about the end product. Presentations should discuss the problems faced, and the solutions used. There should be particular emphasis on progress into new areas of knowledge."

Then this guidepost communication continues:

"We do not want to be a sounding board for nontechnical papers. In the past, unfortunately, some papers have been given in SAE meetings which were hardly more than advertising of a product.

"The SAE Passenger Car Activity, therefore, is asking each of you who has so kindly agreed to serve as chairman of a technical session to communicate to the particular authors our desire to maintain a high standard for papers. . . . Authors can wisely ask themselves to consider the varied cross-section of engineers in SAE, and then decide how to present the subject in a manner which will interest those engineers to the greatest extent."

Record number of companies participating in . . .

SAE Engineering Display

. . . at the Sheraton-Cadillac Hotel, Detroit, Jan. 11-15

Aeroquip Corp.
Al-Fin Corp.
Allegheny Ludlum Steel Corp.
Aluminum Co. of America
American Bosch Div., American Bosch Arma Corp.
Anchor Coupling Co., Inc.
Armco Steel Div., Armco Steel Corp.
Associated Spring Corp., B-G-R Div.
Avon Tube Div., Higbie Mfg. Co.

Bacharach Industrial Instrument Co.
Bendix Aviation Corp.
Bendix Filter Div.
Bendix Products Div.
Bendix Radio Div.
Eclipse Machine Div.
Lakeshore Div.
Marshall Eclipse Div.
Sheffield Corp.
The Beryllium Corp.
Bolling Wheel & Axle Div., Anderson-Bolling Mfg. Co.

Chelsea Products, Inc.
Cities Service Oil Co.
The Cleveland Graphite Bronze Co., Div. of Clevite Corp.
Continental Motors Corp.

Dana Corp.
Dayton Industrial Products Co.
A Div. of the Dayton Rubber Co.
Detroit Aluminum and Brass Corp.
Detroit Controls Div., American-Standard
Detroit Diesel Engine Div., General Motors Corp.
The Dow Chemical Co.,
Magnesium Sales Dept.
The Dow Metal Products Co., Div. of the Dow Chemical Co.
Dualoc Drive, Inc.
Ductile Iron Div., International Nickel Co., Inc.

E. I. du Pont de Nemours & Co. (Inc.)
Elastomer Chemicals Dept.
E. I. du Pont de Nemours & Co. (Inc.)
Polychemicals Dept.
Electric Autolite Co.
Enjay Co., Inc.

Fawick Brake Div., Fawick Corp.
Flexonics Corp.
Fram Corp.
The Garrett Corp.,
Airesearch Industrial Div.

General Radiator Inc.
Gillett & Eaton Inc.
Grob, Inc.

Heli-Coil Corp.
Hercules Motors Corp.
Heyer Industries, Inc.
The International Nickel Co., Inc.

johnson Bronze Co.

Kaiser Aluminum and Chemical Sales, Inc.
Kelsey Hayes Co.
Kistler Instrument Corp.
Kolene Corp.

Lipe-Rollway Corp.
Lisle Corp.
Lord Manufacturing Co.

Midland-Ross Corp., Owosso Div.
Molded Fiber Glass Body Co.
Monroe Auto Equipment Co.

Perfex Corp.

Reynolds Metals Co.
Rosan, Inc.
Ross Gear & Tool Co., Inc.
The Satullo Co.

Spray Products Corp.
Stratoflex, Inc.

Thompson Ramo Wooldridge Inc.
The Torrington Manufacturing Co.
Tyrex, Inc.

Unison-Action Seat Div., American Metal Products
United States Steel

Vickers Incorporated

Walker Mfg. Co. and Deluxe Products Corp.
Waukesha Motor Co.
Webb Forging Co.
Wyman-Gordon Co.

Zollner Corp.

SAE Authors Among Industry's Ambassadors

WHEN AN ENGINEER AUTHORS AN SAE PAPER he is apt to find himself in print in many media — and in many languages. SAE's Preprint of his paper, kept available for a year, and the inevitable SAE Journal abridgment often are just the beginning.

The SAE Headquarter's file dubbed "Permissions" shows that one in every three SAE papers gets attention from other-than-SAE publications . . . and that one in every four gets feature or semi-feature treatment.

Most of these "treatments," of course, are in publications with relatively small duplication of circulation with SAE Publications — and usually tend to emphasize phases of the paper which are of most interest to other-than-SAE audiences. SAE Journal concentrates on being first with articles specially tailored to its audience, based on material drawn from *all* SAE sources . . . papers, committee reports, presentations to and within individual committees, and so forth.

The "Permissions" file, dealing especially with requests to reprint major portions of SAE Journal articles or SAE papers, shows — in the last 15 months — 173 requests for permission to publish in other media — here and overseas.

Here are the facts on these requests — which referred either to reprinting from SAE Journal's abridgment of a paper or directly from the paper itself:

- 36 American magazines published material from 60 papers
- 9 American universities published material from 21 papers
- 10 U.S. Government agencies published material from 39 papers
- 3 American Foundations published material from 7 papers
- 18 Overseas magazines published material from 46 papers

American Magazines

The 36 American magazines which published material from 60 papers are:

Steel
Power Transmission Design
Space Aeronautics
Modern Metals
Precision Metal Molding
Diesel Power & Equipment
Petroleum Engineer
Product Engineering
Metal Progress
The Glass Industry
Diesel Progress
Small Car Parade
Oil & Gas Journal
Materials in Design Engineering
Quality Control
LPGA Times
Refrigerating Engineering
Michigan Contractor & Builder
Speed Age
Western Trucking
Products Finishing
The Florida Engineer
Modern Castings
American Agricultural Reports
Magazine of Standards
Jaguar Journal
GO — Transport Times of the West
Motor Cargo
National Petroleum News
Noise Control
Plating
Power Wagon
Modern Highways
Mercedes Benz Star
Encyclopedia of Science & Technology
Truckers Maintenance Digest

Universities and Schools

The nine universities and schools which made use of SAE-author material — in books or as part of course material during these 15 months — are:

University of Michigan
Tri-State College
Massachusetts Institute of Technology
University of Wisconsin
Columbia University
University of Pittsburgh
Washington Institute of Technology
Oregon State College
Milwaukee School of Engineering

And the Government Agencies are:

Ordnance Weapons Command
Detroit Arsenal, Design Branch
Schilling AFB — Kansas
U.S. Army Ordnance School — Aberdeen
U.S. Navy Underwater Lab
U.S. Engineering & Development Labs
U.S. Military Academy — Ordnance Dept.
U.S. Corps of Engineers
Air Research & Development Command
U.S. Navy Post Graduate School

Foundations and Associations

The Flight Safety Foundation used two SAE papers, and the Air Pollution Control Association, five.

Other Countries

In England alone, 10 publications deemed American engineering know-how of sufficient interest to re-publish the material of 33 SAE authors. These magazines are:

Scientific Lubrication
The Motor Vehicle
Machinery
Motor Cycling
Journal of Institute of Motor Industry
Engineering Materials & Design
Light Metals
Institute of Petroleum Journal
SMRE Reports of Ministry of Power
Journal of Municipal Passenger Transport Association

Other requests were received from magazines and companies in Mexico, France, Italy, Belgium, Holland, Switzerland, Germany, Australia, Puerto Rico, Argentina, Brazil, and India.

IN ADDITION, 64 American automotive companies requested reprint permission of 72 papers for circulation among their engineering staffs, for abstracting for use of their service people, and so forth.

And small quotes from scores of SAE papers find themselves hundreds of outlets, SAE "Permissions" file records.

YOU'LL . . .

. . . be interested to know . . .

CAMPUS NOTE: "Parking is the biggest problem at almost every college on the Pacific Coast," reports an SAE official who recently visited a number of Coast campuses. "There are so many automobiles on nearly every campus — and so little real estate available for parking them. In some cases, it is anticipated that the parking permit sooner or later will cost the student more than his tuition."

H. L. BROWNBACK and V. G. RAVIOLO have accepted SAE's invitation to present papers at the Federation Internationale des Societies d'Ingenieurs des Techniques de l'Automobile at The Hague next May.

The Passenger Car Activity Committee arranged for Brownback's presentation, which will be titled "Why American Cars are Like They Are" . . . . Raviolo's presentation will be titled "Laminar Flow Body Design," and was arranged for by the Body Activity Committee.

Other Activity committees are also in process of developing authors and papers for the forthcoming FISITA meeting, at the request of SAE Council.

Official Notice

The Annual Business Meeting of the members of the Society of Automotive Engineers will be held on Monday, January 11, 1960, at 7:30 p.m., at the Sheraton-Cadillac Hotel, Detroit, Mich., as part of the Annual Meeting of the Society.

SAE NATIONAL MEETINGS

- **January 11–15**
  Annual Meeting (including engineering display), Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

- **March 15–17**
  National Automobile Meeting, The Sheraton-Cadillac, Detroit, Mich.

- **March 22–24**
  National Production Meeting, Statler Hotel, Cleveland, Ohio

- **April 5–8**
  National Aeronautic Meeting (including production forum and engineering display), Hotel Commodore, New York. N. Y.

- **June 5–10**
  Summer Meeting, Edgewater Beach Hotel, Chicago, Ill.

- **August 16–19**
  National West Coast Meeting, Jack Tar Hotel, San Francisco, Calif.

- **September 12–15**
  National Farm, Construction and Industrial Machinery Meeting (including production forum and engineering display), Milwaukee Auditorium, Milwaukee, Wis.

- **October 10–14**
  National Aeronautic Meeting (including manufacturing forum and engineering display), The Ambassador, Los Angeles, Calif.

- **October 25–27**
  National Transportation Meeting, Hotel Leamington, Minneapolis, Minn.

- **October 31–November 1**
  National Diesel Engine Meeting, Hotel Cleveland, Cleveland, Ohio

- **November 3–4**
  National Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

SAE IN THE NEWS

A FORMER SAE VICE-PRESIDENT, Jack L. S. Snead, Jr., was the subject of a **New York Times** "Personality" profile recently. Spotting Snead as "president of the world's largest trucking company — Consolidated Freightways" — the profile detailed Snead's view that trucks should be tied in with all other modes of transportation by wider use of "through rates."

Consolidated, the article continues, is the only major trucker who has made through rate agreements with the railroads. . . . and so far Snead is the only major trucker willing to admit that:

"While motor carriers usually can move almost any major commodity between almost any two points not more than 100 miles apart far more cheaply than a railroad, the railroad can move it a long way at much lower cost than the trucks."

"BILTEKNIKEN VID GRANSLINJE 'CYLINDERVALLEN' KRAVER ENORM FORSKNINGSINSATS" is the title of the front-page story in Stockholm's Svenska Dagbladet on SAE President Raymond's recent visit to that city. It's an extensive story and carries a large picture of President Raymond.

"SEVERAL TIMES EACH YEAR one estimable gentleman or another from the precincts of Detroit mounts the podium at a meeting of the Society of Automotive Engineers and looks into the future. He sees cars with engines reduced to the size of teakettles. Or cars so low that their wheels rise above their roofs. Or, indeed, cars without any wheels at all."

This is how Devon Francis started off his almost-two-full page article titled "Some Dreams, F.O.B. Detroit" in the Oct. 25, 1959, issue of the Sunday New York Times Magazine.

Calling All SAE Consultants!!

THE 1960 issue of SAE Consultants is being prepared. All members who do consulting work are invited to register. (Last year's listings will be carried into the 1960 issue automatically.)

This list has been a popular publication of the SAE Placement Service since its first issue in 1958. It goes to approximately 1500 employers each year.

Registration forms may be obtained from your Placement Service at SAE Headquarters, 485 Lexington Avenue, New York 17, N. Y. The CLOSING DATE for the 1960 issue is DECEMBER 31, 1959.

New Trucks feature smooth rides and quiet engines

TORSION BAR springing for better truck ride points up the advanced thinking on vehicles that keynoted the largest triple meeting held to date. The ever broadening engineering approach results from the tightening demands that vehicles perform better, carry more load, be lighter, cost less, be cheaper to maintain, and last longer. The combined Transportation, Diesel Engine, and Fuels and Lubricants National Meetings took a giant step toward answering some of these demands.

Dynamic balance was pinpointed as a trouble spot in high-speed commercial vehicles. Both the engine and the tire and wheel assemblies were scrutinized and new benchmarks of performance established. The unbalance of wheel assemblies also tied in with the riding qualities of trucks.

Powering the vehicles of tomorrow will be light economical engines. Part of the engine answer is the multi-use of machine tools to keeps costs of component parts for a whole series of engines at a minimum. Other potentials are the extended use of aluminum and superchargers that can use lower alloy steels. Also, governing engines so their output and life meet tighter demands came up as an important phase of today's and tomorrow's engines.

Engineers got a frank look at the corrosion problems in the field as fleet operators reported the advanced techniques they employ to repair accident damaged parts and to prevent corrosion in sensitive areas. Special protective coatings and corrosion conscious designs promise to check the problem.

Engine noise is under vigorous attack from the fuel and lubricant experts. Some of the advances include: tertiary-butyl acetate additive for a cheaper high-octane fuel, seasonal octane control to better match engine requirements with a corresponding saving in production costs, rating fuels at part throttle, and controlling luboil contribution to surface ignition.

For a change of pace, engineers saw the Chicago's Science and Industry Display, which highlighted diesel power, petroleum production, peaceful atoms, and the evolution of transportation. Also, there are some SAEers who now believe it could happen to them as a result of hypnotist Edwin Baron's demonstration at the Wednesday luncheon.

W. A. Gebhardt, Chicago Section chairman, welcomed engineers on behalf of the host section. General Committee Chairman G. E. Stoll lead the extensive planning and execution that made the meeting a resounding success. The Activity Vice-Presidents R. R. Robinson (Diesel) Lloyd Withrow (Fuels and Lubricants), W. E. Thill (Transportation and Maintenance), and R. W. Wantin (Truck and Bus) and many of their co-workers were present to see the fruits of their technical planning and to continue work on future information development.

Capsules of Technical Papers

Precision Engine Balancing — In the the last few years, many truck engines have been precision balanced to the same tolerance as the finest racing engines. The minimum return from precision balancing, over and above commercial balancing tolerances (reported by truckers who have kept accurate records), has been 25% increase in engine life between teardowns. Reported increases of 100% are common. The figure varies with the operating speeds of the engines involved. The development of job-type balancing machines which can be applied to maintenance operations has made the advantages of balancing available to vehicle users, as well as manufacturers. (Paper 114T)

Use of Balancing Tools — Increasing engine speeds and increasing road speeds are making unbalance of engine rotating masses a major problem. Precautions that should be taken for

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Papers on which these capsules are based are available in full in multilith form from SAE Headquarters. See order blank on page 6.

proper balancing are:

1. Careful weighing and balancing of component parts.

2. Differences in 6-cyl and V-8 engines should be recognized and proper procedures followed by balancing both, for even weighed sets of parts may throw unbalance into the V-8 if the parts are not of the specified weight.

3. Run-out of mating rotating parts with respect to each other introduces unbalance in the assembly, even though the respective parts are in balance.

4. Engine assemblies can be balanced only after taking these precautions. The equipment is available for both permanent and portable installations. (Paper 114U)

Corrosion Cost Reduction — Steps recommended for protecting surfaces of commercial vehicles are:

1. Careful appraisal and selection of equipment.

2. Frequent washing (especially of underbody areas) and adequate inspection to insure early repair of minor damage to paint film.

3. Accurate and meaningful record keeping on the paint condition of each operating unit.

4. Association with an experienced and reputable paint manufacturer who has adequate technical facilities.

5. A firm intention to use correct prepainting methods and the best and most appropriate paint for the particular job at hand.

6. Thorough supervision of the actual painting to assure that the stipulated system is correctly followed by painting personnel. (Paper 115T)

Corrosion-Free Design with Aluminum — In designing structures for aluminum, first consideration is usually given to fulfilling the mechanical or physical requirements. The article being designed must have sufficient strength to withstand the service conditions during its initial period of use and must remain in serviceable condition for some minimum period of time. Therefore, factors which are functions of time must be taken into consideration: fatigue, creep, certain metallurgical transformation, and corrosion. Corrosion is the most difficult to estimate because the specific service conditions which affect it are not known in advance.

Good design in transportation equipment begins with the proper choice of alloy and alloy combinations and incorporation of proper joint geometry. But without periodic checkups and maintenance by the operator, care in design is wasted. (Paper 115U)

Corrosion Maintenance — A fleet operator reports that his company has been unable to devise an effective and sure-fire method of overcoming deficiencies in design, construction, assembly, preparation of metal, and painting — all of which, together with the use of road salts, contribute to corrosion. However, he has developed a method of repair he finds relatively inexpensive and effective in postponing a recurrence of the original troubles:

1. Chip off all loose metal from corroded area.

2. Sand area and paint with a coat of "polyester resin."

3. Before resin dries, cover area with fiberglass matting.

4. Saturate fiberglass matting with resin and allow to dry.

5. Sand matting, fill any depressions or hollows with a fiberglass putty, allow to dry, and sand again.

6. Paint with another coat of resin. While still wet, apply and mold a layer of fiberglass cloth fabric to area.

7. Saturate with three coats of resin, drying between coats.

8. Sand area smooth, filling in any imperfections with fiberglass putty.

9. Prim and paint as you would bare metal. (Paper 115V)

New Lightweight Diesels — International Harvester has developed a new line of lightweight, high-speed diesel engines for agricultural and construction applications. This diesel has also been used in highway vehicles.

The family consists of four 6-cyl engines having a displacement range of 236–301 cu. in. Engine weight with fan, generator, and cranking motor ranges from 860 to 950 lb, depending upon end product application. Engine dimensions are 39.47 in. long (less fan), 21.28 in. wide, and 29.91 in. high. The extensive use of interchangeable parts was a basic design concept of the engines. (Paper 116T)

Designing Brakes — Considerations in brake and brake drum rating, design, and testing are:

1. An engineering term to define brake, brake linnig, and brake drum heat dissipating ability is necessary. One possible step in this direction is the term "continuous horsepower."

2. Cast iron is an excellent brake drum material.

3. Brake lining material is a current weak link. Unless a major breakthrough in this area is forthcoming, no major strides in reducing both the weight and cost of brake and drum assemblies appears possible.

4. Under the limitations imposed by current materials, the major element not yet sufficiently appreciated by the industry is drum positioning and exposure.

5. Dynamometer testing of brakes and brake drums is more precise than highway testing, but cannot be used exclusively. The final proof-testing of all elements involved must come from actual use on the highway. (Paper 117T)

Maintenance of Heavy-Duty Brakes — A maintenance department should have to handle only those vehicles which have been carefully selected for the particular operation. Undersized and underbraked vehicles are a continuous expense. Other considerations are:

1. The vehicle should be equipped with brakes having a potential of long-service life between relines and with a minimum requirement for lubrication and adjustment.

2. The brakes on all units should be synchronized as regards airflow timing and power balanced in relation to the loads.

3. The environment in which the brake operates should insure the low-

That entrancing luncheon . . .

It started with an air of innocence as Toastmaster Merrill Bennett made the introductions. Seated beside him (r. to l.) are Hypnotist Edwin L. Baron; and W. A. Gebhardt, Chairman, Chicago Section.

Soon Mr. Baron had convinced some SAEers that it was getting hotter . . .

and hotter . . .

est possible brake operating temperatures.

4. The loads, speeds, and grades to be negotiated must be within the economic capabilities of the wheel brakes or a supplementary brake (retarder) will be necessary for economical operation. (Paper 117U)

New Polydiesel Engines — Two new polydiesel engines are now being produced by Hercules — a 6-cyl in-line (D-426) and a V-8 (DV-662), in both naturally aspirated and turboblown versions.

The 6-cyl engine cylinder block is cast iron, the V-8 aluminum. Thus, the weight of the naturally aspirated engine, with fuel handling equipment and complete luboil system (including cooler and oil pan for high tipping angle in every direction), is only 1540 lb; the turboblown version weight 1600 lb. This results in specific weights of 7.7 and 5.3–4.6 lb per bhp, respectively.

The turbulence change results in high power output — 110 bmep at maximum speed and 120–125 psi at maximum torque for the naturally aspirated engine.

The polydiesel design permits placement of the auxiliary chamber relatively far out from the cylinder axis. This allows water flow distribution which will avoid cracking of cylinder heads. (Paper 118T)

Comprex Supercharged Diesel Truck — The Comprex supercharger, using a new principle to utilize exhaust gas energy for the precompression of air, gives desirable operating characteristics for a truck diesel engine. The system has been tested over 20,000 miles. Response, clean exhaust, fewer gearshifts, and improved fuel consumption are the predominant advantages of the system.

Performance characteristics were:

1. Delivery of high air density over a wide engine speed range.
2. Immediate response to load changes.
3. Altitude tests up to 12,000 ft have proved the feasibility of the device to maintain power at altitude. (Paper 118U)

Heavy-Duty Crankshaft Seals — When designing equipment, the engineer should consider these factors about front crankshaft seals:

1. Oil seal cavity should be adequate with ample drain-back holes, sufficient to carry off the maximum flood of lubricant. This insures optimum operating conditions for the seal with no sacrifice in lubrication of the moving parts.

Adequate chamfers (30 deg × 1/16 in. at the leading edge of the bore, and 30 deg × 3/16 in. on the end of the shaft) must be provided to minimize seal distortion when it is pressed into the bore or passed over the shaft.

Rear crankshaft oil seals fall into two categories: (1) completely round seals which ride on the flywheel flange or flywheel flange hub; and (2) split seals, which ride on the crankshaft with the attached flywheel extended to the rear. The latter seal is made in two halves, which are pressed together on the shaft, as the outer sections are confined or retained. (Paper 119T)

New Oil Seal Designs — The general progress in the mechanical shape of oil seals, coupled with new synthetic elastomers, has been a large factor in improving performance. The better seal is a result of these basic design concepts all contributing to low torque and less drag:

1. Sealing head design resulting in a narrow shaft contact directly under the garter spring.
2. The rubber head "bonded" to a metal part to eliminate deformation from internal seal assembly pressure or press-fit upset.
3. The rubber mixture compounded specifically as a shaft seal material without deviation required to allow use of nonbonded and less expensive mechanical designs. (Paper 119U)

Unitized Seals — A unitized seal is an oil seal which runs on a surface incorporated in the oil seal assembly as an integral part. The wear sleeve is incorporated as an integral part of the seal assembly. The wear sleeve is provided with a rubber lining which is a press fit over the shaft, and also serves as a driver of the wear sleeve. The rubber lining is carried around the edges of the wear sleeve and small projections serve to locate the wear sleeve within the outer case. In service these projections wear off and the initial torque drag due to them soon disappears. The seal itself is conventional in every respect.

Advantages include ease of installation, self-lubrication, and performance independent of shaft condition. (Paper 119V)

"Factor of Safety" — The adequacy of a given engine design from the structural standpoint requires that the part be strong enough for the anticipated service conditions. At the same time, the imposed stress must not be very much less than the strength if the design is to be practical. Thus, a satisfactory design must be characterized by a proper balance between the stress and the strength.

A reliable method of finding a factor of safety requires that all the factors affecting the stress and strength to be considered individually. The balance between the two would be smaller than the conventional factor of safety because it would have to account only for occasional overloads, production and service variations, and the like. (Paper 120T)

Aluminum Diesels — The use of aluminum for the major components of liquid-cooled and aircooled diesel engines is coming into increased acceptance in commercial as well as military applications. The thermal characteristics make it a very acceptable material for the high-output turbocharged engine.

The production cost savings realized in tooling, machining, and handling, along with the availability of aluminum, make it a very attractive material for high-output, high-speed, and lightweight diesel engines. (Paper 120U)

Truck Riding Comfort — The primary requirement of today's truck is

DISCUSSING the meetings progress at a reception before the luncheon are (l. to r.) J. B. Duckworth, Fuels and Lubricants Meeting chairman; R. W. Wantin, vice-president for Truck and Bus; W. E. Thill, vice-president for Transportation and Maintenance; R. R. Robinson, vice-president for Diesel Engine; and W. L. Cook, Transportation and Maintenance Meeting chairman.

that it carry loads quickly, dependably, and profitably. Until recently, a high load capacity and a reasonably comfortable ride were incompatible. High load capacity requirements led to designing suspensions which adversely affected driver comfort.

Items having the greatest effect on ride are the deflection of the spring system, the inertia effect of the sprung mass, and the wheelbase. These determine the bounce and pitch frequencies and their respective oscillation centers. Probably the most important is the spring system deflection. Chevrolet has met this problem by designing an independent front suspension for its new series of trucks. This system not only gives greater comfort, but also improved vehicle stability and handling. (Paper 121T)

Electric Governor — A high-frequency transistor inverter and magnetic amplifier circuits (which reduce the inherent delays from the time a frequency error is recognized to the time a throttle correction is initiated) have been incorporated in the Westinghouse EFG governor. Elimination of a three-phase load-sensing circuit plus a reduction in component size characteristics of high frequency design have resulted in size and cost reduction and simplified installation.

The governor is a speed (frequency) regulating servo for prime movers driving a-c or d-c generators or mechanical loads. It provides high control sensitivity, fast response, and minimum speed (frequency) deviations with load fluctuations. The governor features electrical frequency sensing, rugged static components, and no electronic tubes. (Paper 122T)

Governors for Agricultural Diesels — A new governor on diesel engines for agricultural applications has been developed by Pierce Governor Co. It is mounted on the engine accessory drive and is driven from the timing gear trains. The governor lever is connected to the rack bellcrank by means of a ball-joint linkage. Engine speed is adjusted by means of a manually controlled linkage to the governor speed change lever. Maximum speed is limited by adjustment of the high-speed stop bracket. This governor (Model GC-6905) controls the engine at all speeds from slow idle to 1850 rpm full load, depending upon the position of the speed change lever. (Paper 122U)

Diesel Electrical Requirements — To meet today's specifications for precise electrical power, the diesel engine must measure up to critical performance requirements. The Woodward load-sensing governors (LSG) were developed to meet this problem. They combine the reliability and accuracy of a precise mechanical hydraulic speed-sensing governor with the extremely rapid response of the electrical load-sensing governor.

One such model is an isochronous hydraulic speed and load-sensing governor with a work capacity of 1 ft-lb (LSG-1). It takes its oil supply from the engine and boosts this oil pressure through the governor oil pump and relief valve system to the 300+ psi operating pressure. The response time of the LSG-1 to a 100% step load change is about 1/100 sec to position the fuel racks to the new value. This is so rapid that on most engines the fuel pumps would have reached their new position before the next cylinder was ready to receive its fuel change. (Paper 122V)

Governors for Small Engines — Curtiss-Wright has developed an isochronous governor which is becoming widely used on small diesel and gasoline engines. The system is a feedback or loop-stabilized one consisting of a speed sensitive control element, power output element, and a stabilizing element. The combination forms a speed-sensitive hydraulic mechanism.

Advantages of the system are:

1. Meets the same physical specifications that are required of the small engine builder — compact, rugged, light, fast, and inexpensive.
2. Provides a wide degree of flexibility in mount and drive requirements.
3. Operated from external oil supply or can be self-contained.
4. Can be easily complemented with load-sensing equipment. (Paper 122W)

Spark-Plug Misfiring — Quantitative measurements of spark-plug misfiring have been obtained with a new electronic misfire counter. With this instrument, misfiring severity was shown to differ from cylinder to cylinder in the same engine and to vary with time even in the same cylinder. Misfiring severity was shown to decrease when:

1. Deposits were accumulated at successively higher temperatures.
2. Engine conditions during deposit buildup were varied to yield higher maximum spark-plug temperatures although the average temperature was unchanged.
3. A phosphorus compound was added to the deposit accumulation fuel.
4. Fuel octane quality was increased to eliminate knock during accelerations. (Paper 123T)

Spark-Plug Life in Two-Stroke Engines — Average spark-plug life in two-stroke engines has been found to be only 32 hr of satisfactory operation be-

fore failure, and to range from 0.2 to 100 hr. Failure of spark plugs consists of many things — cold fouling, lead fouling, bridging, missing, and refusal to start a cold engine. The real trouble may be ignition, carburetion, or engine condition, but is not checked by many owners. Laboratory tests are inconsistent because no satisfactory measure of when a plug has failed exists at present, nor does there exist a definition of spark-plug failure which is recognized by all those working with two-stroke engines. Spark-plug manufacturers could obtain much better data from engine manufacturers' laboratories if such a definition were made for use in evaluating new spark-plug designs. (Paper 123U)

Two-Stroke Engine Spark-Plugs — Two-stroke engines have reached a severity level which is resulting in increased failure. Basic requirements of plugs are:

1. Maximum plug temperature should be below the point of preignition at rated speed.
2. Insulator firing end should be sufficiently long to prevent rapid fouling of the insulator.
3. Gap electrical erosion should be reasonable to keep the voltage requirement of the plug within the limitations of the ignition system.
4. Electrode temperature should be maintained below a level where either oxidation or corrosion will destroy the electrode material.
5. If deposit preignition occurs, the plug should not reach its preignition temperature.
6. The plug should be capable of tolerating the deposit without being gap bridged, insulator bridged, or fouled by insulator deposit.
7. The plug should prevent, if possible, the attachment of a foreign deposit of sufficient size to cause preignition. (Paper 123V)

Automatic-Transmission Failure — The low-temperature clutch-plate failure typical of step-type transmissions has been found to be directly related to the viscosity of the automatic transmission fluid.

In experiments with 34 transmission fluids it has been found that at a critical viscosity value, called the failure viscosity, the transmission failed according to the standards used in judging the condition of the clutch plates. In comparison to the strong temperature dependency of the viscosity at low temperatures, as a first approximation, the value for the failure viscosity was found to be fairly constant, for example, 4900 ± 1200 centipoise. A mathematical analysis of the transmission function at low temperatures gave a failure viscosity of approximately 5300 centipoise which was in reasonable agreement with the experimental value. (Paper 124T)

Transmission Cold-Weather Operation — Autcmatic transmission fluid low-temperature Brookfield viscosities are being used to evaluate fluid performance under extreme cold conditions. Laboratory test have indicated:

1. Lighter viscosity base oils offer the best low-temperature fluidity.
2. Equivalent automatic transmission fluid viscosity characteristics can be obtained with widely different mineral base oils.
3. V.I. improvers are one of the major factors controlling low-temperature viscosity.
4. Detergents, antioxidants, and antisquawk agents have a minor additive on viscosity. In general, they increase the viscosity of the base oil-V.I. improver combination. (Paper 124U)

Automatic Transmission Fluids — Conclusion of tests on shear stability run by Enjay Laboratories on automatic transmission fluids are:

1. High-speed driving is more severe than city driving in terms of the shear stability of an automatic transmission fluid.
2. The type of transmission is an important variable.
3. The amount and type of V.I. improvers used in a fluid have a very important effect.

And on rubber swell:

1. Volume swell is a function of the specific gravity of rubber seals when fluids containing naphthenic components are being tested.
2. With fluids containing all paraffinic base oils, there appears to be no relationship between rubber swell and specific gravity of the rubber sample. (Paper 124V)

Noise in Diesel Engines — The mechanism of the generation and radiation of engine noise is complex. Air intake noise, and valve and timing covers are liable to be strong sources of noise. Reduction of the noise from them may produce a major quieting; and mechanical noise, or in extreme conditions injection equipment noise, may then be prominent. In some engines a contribution should be obtainable by smoothing the cylinder pressure.

All of the remaining sources are believed to involve resonant vibrations of the crankshaft-flywheel system, the crankshaft, or the crankcase. Stiffening is not likely to have much effect on the magnitude of noise, though its "quality" may be altered by displacement toward higher frequencies.

Since the mechanical amplifications involved are high a major reduction of noise should be obtainable by introducing damping great enough to approach critical damping. (Paper 125T)

Ignition Time Delay — Researchers at the University of Wisconsin have used two techniques to study physical and chemical ignition delay in diesel engines: the hot-motored and the nitrogen. Three pressure-time records were obtained — one without either vaporization or chemical reaction, one with vaporization only, and one with both vaporization and chemical reaction. By comparison of these three records, rates of vaporization and rates of chemical reaction can be determined during the ignition delay period in an operating diesel engine. (Paper 125U)

Oil for High-Output Engines — Today's high-output automotive engines operate a signficant portion of the time under low power factor and low-to-moderate temperature conditions. The low-duty operating condition is conducive to the oxidation and polymerization of fuel blowby products with little oxidation of the oil. These products result in varnish and sludge deposits in the engine if they are not properly controlled. The low-temperature oxidation mechanism does not appear to lend itself as readily to accelerated test conditions as does its high-temperature counterpart. This, combined with the generally high performance level of today's oils, is resulting in a trend toward longer term laboratory engines tests.

This trend means higher test costs. The Continental Oil Co. has developed tests methods which they believe an-

A MASS ATTACK on the tire and wheels unbalance problem was executed by an eight-man team of experts from the truck, wheel, tire, and operating industries.

swers some of this problem. (Paper 126T)

Causes of Combustion Deposits — In a laboratory procedure developed with a production model V-8 engine, a single deposit accumulation cycle shows the effects of motor oil composition of octane requirement increase, surface ignition, rumble, and spark-plug fouling. The engine is cycled to simulate city driving for 200 hr. Tests on seven commercial 10W-30 oils show that octane requirement increase is affected more by motor oil differences as compression ratios rise. Surface ignition, rumble, and spark-plug fouling are alleviated by phosphorus in motor oil additives. A threshold concentration of about 0.1% appears to be necessary for effective control of surface ignition and rumble; amounts as low as 0.05% reduce spark-plug fouling. If future engines with higher compression ratios, careful selection of motor oil components should contribute even more to combustion control. (Paper 126U)

Engine Cleanliness — A series of three taxicab field tests has been run to determine the potential for V.I. improver/dispersant multifunctional additives in 10W-30 graded oils. The tests covered 18,000–25,000 miles of operation of severe stop-and-go service in New York City.

The conclusions show that the best way to keep engines clean in normal and severe short trip, stop-and-go type of driving is to use a multigraded oil containing both a polymeric V.I. improver/dispersant and a detergent-inhibitor. Another finding is that undesirable interactions between V.I. improver/dispersants and detergent-inhibitors may manifest themselves by poor engine performance. (Paper 126V)

Seasonal Octane Control — Weather and its associated variables affect not only the ability of fuels to satisfy customer cars, but also the reproducibility of fuel ratings. Based on a recent study, relationships have been developed wherein fuel ratings and engine requirements can be adjusted to a standard condition, which is more precise.

Seasonal octane numbers were found to result in lower annual octane numbers which means lower cost. In the future as octane numbers and gasoline taxes increase, seasonal octanes will probably become more economically attractive. (Paper 127T)

Octane Improver — Tertiary-butyl acetate (tla) possesses many of the characteristics of an ideal gasoline additive: it is miscible with all type of hydrocarbons in the gasoline boiling range, compatible with lubricating oil, insoluble in water, a nontoxic liquid boiling in the middle of the gasoline boiling range, has a freezing point below – 75 F, and can be prepared from cheap materials.

In tests, this additive gave significant improvement in the Research, Motor, and road octane numbers of leaded, high-octane, commercial-type motor gasoline. The magnitude of these improvements were found to depend strongly on the amount of tel and tla used in the fuel. Extensive laboratory engine and road testing, as well as limited area marketing studies, have indicated that the additive can be recommended for commercial use. (Paper 127U)

Induction Systems — Studies with conventional and modified compression ratio engines have indicated that the variations in road octane performance of fuels with similar Research octane ratings could be explained by considering their sensitivity and the fuel's olefin content. Tests have recently studied the effects of various induction systems on fuel road performance.

In three of the five investigations multicarburetor systems reflected increases in sensitivity to a less degree than the same engines equipped with four-barrel carburetors. In only one instance was the change in road ratings greater than that obtained with a four-barrel carburetion system. The ratings obtained with the supercharged engine were affected the least by increased sensitivity. The fuel injected engine produced ratings which were altered by sensitivity increase to about the same degree as its carburetted counterpart. (Paper 127V)

Part-Throttle Knock — The most important fuel factor in controlling part-throttle knock is Motor octane number. In the low-speed range, where most part-throttle knock occurs, Motor octane number has an effectiveness of about unity, and Research has little or no effect on road octane number. Fuel hydrocarbon composition has very little effect on road performance at low speed. In the high-speed range (3000 rpm), increasing the Motor octane number by one unit will increase the road rating by about two units, while increasing the Research octane number will actually decrease the road rating. At 3000 rpm, an increase in aromatic content or a decrease in olefin content will increase the part-throttle road rating of a fuel. (Paper 128T)

Part-Throttle Fuel Economy — Two automotive engines have been run on dynamometer test stands at conditions of best economy spark time and mixture strength to study operation at road load, part throttle, and full load. Comparisons of octane quality demand on the basis of both primary reference fuels and CRC, full boiling range, sensitive reference fuels were made.

The data indicate that increases in road-load fuel economy in the order of 10% are possible with such engines but that under these conditions they become knock limited on commercial-type gasolines at part throttle, rather than full load. In such cases, Research octane quality can be depreciated 16 numbers or more.

Primary reference fuel data indicate, conversely, that with fuels of zero sensitivity, full-throttle results continue to predict maximum octane requirement, even when engines are tuned to yield maximum fuel economy. (Paper 128U)

Fuel Vehicle Rating — The recent CRC test program was designed to study the vehicle rating characteristics at various throttle positions of fuels of different sensitivity and hydrocarbon composition. Results show that:

1. Fuel ratings relative to primary reference fuels decrease rapidly with increasing part-throttle manifold vacuum. Engine octane number requirement also decreases.

2. While part-throttle knock was generally not a severe problem in the cars used, some cars operating on some fuels did have critical knocking areas at manifold vacuums above 10 in. of Hg.

3. The test fuels which showed the greatest depreciation between full and part throttle ratings had the highest sensitivity and highest olefin contents. (Paper 128V)

EXHIBITS at technical sessions aroused interest. The two shown are IH's new lightweight diesel and a truck tire before and after it becomes round.

SAE SECTION MEETINGS

ALBERTA

January 15 . . . D. L. Hay, industrial sales engineer, Imperial Oil, Ltd. J. R. Caverhill, sales engineer, Imperial Oil, Ltd. "Lubrication." Park Lane Restaurant, Calgary, Alberta, Canada. Dinner 6:30 p.m. Meeting 8:00 p.m.

ATLANTA

January 4 . . . John O. Antonson, technical manager, B. F. Goodrich Tire Co. "Engineering Aspects & Requirements of Ground and Air Vehicles." Dinner 7:00 p.m. Meeting 8:00 p.m.

BALTIMORE

January 21 . . . Harold Skinner, Fuller Transmission Co. "Transmission Maintenance." James Clarke, Lipe Rollway Co. "Clutch Maintenance." Engineers Club, 6 W. Fayette St., Baltimore. Dinner 6:30 p.m. Meeting 8:00 p.m.

BRITISH COLUMBIA

January 18 . . . Student Night. University of British Columbia, Vancouver B.C., Canada. Dinner 7:00 p.m. Meeting 8:00 p.m.

BUFFALO

January 20 . . . J. L. Hooven, executive engineer, Ford Motor Co. C. R. Briggs, public relations manager, Engrg. & Research Staff. "The Falcon." Hotel Sheraton, Delaware Ave., Buffalo. Dinner 7:00 p.m. Meeting 8:15 p.m.

DAYTON

January 21 . . . "Design Features of the Corvair." To be presented by an engineer of the Chevrolet Division, General Motors Corp. Miami Hotel, Dayton. Dinner 6:30 p.m. Meeting 8:00 p.m. Special Feature: Movies & Slides.

FORT WAYNE

January 20 . . . K. D. Butler, farm counselor for AVCO Corp. "The Role of Mechanization in Soviet Agriculture." Hobby Ranch House, Fort Wayne. Social Half-hour 6:30 p.m. Dinner 7:00 p.m. Meeting 8:15 p.m.

METROPOLITAN

January 7 . . . Earl Klinge, executive engineer, advance truck product engineering, Ford Motor Co. "Use of Diesel Engines for Automotive Transportation." Brass Rail Restaurant, Fifth Ave. & 43rd St., New York. Cocktails 5:30 p.m. Dinner 6:30 p.m. Meeting 7:45 p.m.

January 21 . . . A. L. Haynes, director of engineering research & advanced product study office, Ford Motor Co. "Sliding on Air." Henry Hudson Hotel, 57th St. & 9th Ave., New York. Meeting 7:45 p.m.

MONTREAL

January 18 . . . W. D. Drummond, division chief engineer, International Harvester Co. "Automotive Farm Equipment." Sheraton-Mount Royal Hotel, Montreal. Reception 6:15 p.m. Dinner 7:00 p.m. Meeting 8:00 p.m.

NORTHERN CALIFORNIA

January 20 . . . John B. Accnelli, Shell Development Co. "Ball Bearing Lubrication at One Milliam Rpm and 2000 F." Engineers Club, San Francisco. Dinner 7:00 p.m. Meeting 8:00 p.m. Special Feature: Coffee speaker from DuPont. "Key Motivations in Buying Gasoline."

PHILADELPHIA

January 13 . . . Panel discussion. "Aircraft Gas Turbine Fuel Contamination Problems, Requirements and Controls as Viewed by the Petroleum Industry, Airline Operators and Engine Builders." Representatives from Pratt & Whitney, Shell Oil and Trans Canada Airlines. Engineers Club, 1317 Spruce St. Dinner 6:30 p.m. Meeting 7:45 p.m.

ST. LOUIS

January 28 . . . Carl Doman, national service manager, Ford Motor Co. "Future Concepts & Limiting Factors in Automotive Design." Engineers Club, 4229 Lindell, St. Louis. Dinner 7:00 p.m. Meeting 8:00 p.m. Special Feature: Joint Meeting with Engineers Club.

SOUTHERN NEW ENGLAND

January 26 . . . Harold Hoekstra, chief project officer, Transport & Mfg. Division, Bureau of Flight Standards, F.A.A. "F.A.A. Certification of Turbine Transports." Bradley Field, Windsor Locks, Conn. Dinner 6:30 p.m. Meeting 8:15 p.m.

WILLIAMSPORT

January 11 . . . Joint Meeting with A.S.T.E. Chapter 49. James Barbier, Dow Metal Products Division, Dow Chemical Co. "Magnesium for Light Weight Tooling." Young Men's Republican Club, 147 Market St., Williamsport. Dinner 7:00 p.m. Meeting 8:15 p.m. Special Feature: 16 mm Movie "Treasures From the Sea."

SAE SECTIONS

A STUDENT BRANCH CHARTER was presented to Ecole Polytechnique at **Montreal Section** meeting October 19. Guy Perreault (above, right) student chairman, received the charter from A. H. Paton, chairman.

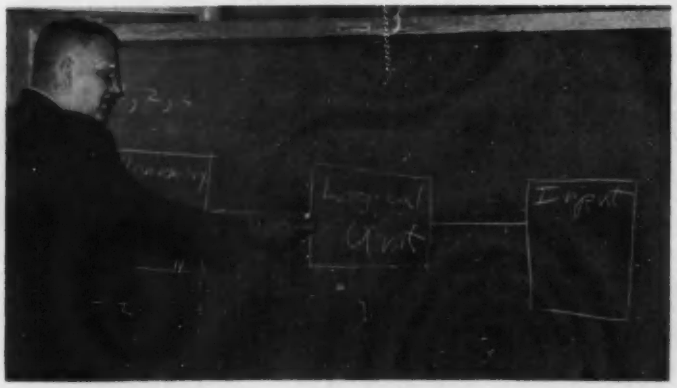
THE DEVELOPMENT OF a high strength corrosion resistant alloy steel used for watch main springs enables watch manufacturers to provide a lifetime guarantee on mainsprings, William T. Reid, assistant technical director at Battelle Memorial Institute, told **Buffalo Section** October 29.

Zinc die castings, Reid said, are limited in their application partly because of the difficulties involved in chrome plating zinc satisfactorily. A research team formed at Battelle to determine the causes of corrosion found that zinc, as cast, is pitted and subsequent coating of copper, nickel and chrome do not fill the pits properly. Another problem is that the chrome plating has minute cracks and pits exposing the nickel plating.

Reid (above, left) is introduced by Richard Batt, program chairman.

D. J. Munro (left) past chairman, received a certificate in recognition of his services during the past year from Chairman A. H. Paton at MONTREAL SECTION October 19.

Herman Stapel, past chairman (left), received a certificate for services during the past year from Elias Scheibe, present chairman at WESTERN MICHIGAN SECTION'S October meeting.



IN FIVE YEARS THE DIGITAL COMPUTER will be able to "think out" a logical solution to problems. Early computers were of mathematical rather than engineering importance; whereas today they can handle instructions in word as well as numerical form. Presently problems of highly theoretical nature are more applicable to the computer. Any problem which can be stated algebracially can be solved by a digital computer, Edwin L. Jacks told **Western Michigan Section,** October 6.

The digital computer, as Jacks illustrates (left), is composed of a (1) memory unit, (2) logical unit, and (3) input-output unit. Instructions given to the input unit will be carried out by the logical unit which relies on the memory unit for previously stored information.

PITTSBURGH SECTION has been awarded a plaque for its work in helping to make the celebration of Pittsburgh's 200th birthday a success. The plaque, a Bicentennial Science Award, was presented to the SAE Section for its cooperation with the City's ASTM group in bringing a scientific speaker to Pittsburgh for a commemoration meeting during the Bicentennial celebration which was held late in October. The featured speaker was Dr. Stewart Way, consultant for Westinghouse Research Laboratories, who spoke on "Propulsion Requirements of Space Vehicles."

PROJECT MERCURY is the most important space project underway in the U.S. today, Dr. Abe Silverstein (right) told **Detroit Section**, October 12. Its objective: to rocket an astronaut in a capsule into orbit around the earth and bring him back alive. The astronaut would be subjected to a peak decelerating force of 8 g's for a period of 6 min when he returns into the earth's atmosphere, a force which man would be able to withstand for that length of time. The Mercury capsule would orbit 3 times around the earth at 18,000 mph after a take-off from the vicinity of Cape Canaveral. The orbit would be an altitude of 100 miles, and would end with the capsule being let down by a large parachute into the Atlantic Ocean east of the Bahamas. The long descent would start over the Pacific Ocean.

A JUDGE'S KNOWLEDGE OF BIRDS AND BEES determined his decision on an accident case in an anecdote told by Nicholas Mussallem at **British Columbia Section** September 21. Mussallem illustrated a judge's difficulty in determining the accuracy of sworn evidence as follows:

A man had claimed non-avoidable accident when his horse was stung by a bee, causing considerable damage to a third party. The judge's knowledge of the birds and bees prompted him to ask, "Is it true that the accident took place in the month of December?" When the reply was "yes," the judge said, "this evidence lacks credibility, as bees are not active during winter months. Therefore I rule that the accident was avoidable."

Detroit Section Presents Three Awards

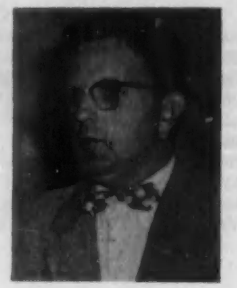
THE HENRY FORD MEMORIAL AWARD for 1959 was presented to James B. Gumbleton for his technical paper "Engine Voltage Requirements Using Spark Plugs Preionized with Radioactive Gold" at **Detroit Section's** October meeting. The award is made annually by the Detroit Section to a junior member of SAE who contributes the best technical paper on a subject related to automotive ground vehicles. It includes a $200 cash prize and a certificate of merit. Gumbleton (left), project engineer for Power Development Group of General Motor Corp.'s Engineering Staff, received the award from Prof. William H. Graves of the University of Michigan.

THE SPRINGER AWARD was presented to Warren M. Wiese (left) for his technical paper "If you Squeeze Them Must They Scream?" by Prof. Graves.

William E. Burnett (left), manager of Lincoln and Mercury engine engineering, Ford Motor Co., received a Certificate of Appreciation for his service to Detroit Section as chairman for 1958-1959. The presentation was made by B. W. Bogan, 1959-1960 chairman.

SAE SECTIONS

A PLANT TOUR of Sunnen Products Co., during which guests were free to wander without a guide, was a featured part of **St. Louis Section's** September meeting. SAE members (above) examine the jaws for an external hone which were "fly cut" in one pass on the milling machine shown in foreground.



Carroll W. Boyce (right), editor of Fleet Owner Magazine spoke at **INDIANA SECTION** October 15 on "The Influence of the User of Vehicle Design." (See SAE Journal, January issue.)

Dr. Vern C. Vanderbilt (left), chief research engineer of Perfect Circle Corp., spoke at **CENTRAL ILLINOIS SECTION** September 28 on "Road Test Recorder Simulator System."

ADDITIVES TODAY far surpass their original intent and impart properties to oil which could never have been achieved previously. Additives, however, have also created problems, such as: valve guttering, high oil consumption, piston undercrown deposits and increased friction, Robert A. Pejeau of Cleveland Diesel Engine Division, GMC told **Fort Wayne Section** on September 23.

HIGHWAY PATROL VEHICLES must attain the speed of 110 mph within three miles, as a minimum acceleration requirement, Jack G. Wogoman of the California Highway Patrol told **Southern California Section** October 12.

Speed trials of prototype cars are made at night on the runway of Palmdale airfield in Antelope Valley, Calif. Most of the cars tested attain the required speed in about one and one-half miles.

G. R. Morgan of Marquardt Aircraft Co. spoke on "Ramjets for Supersonic Aircraft" at South Bay Division of Northern California Section meeting October 6. Jack Harris (left), division chairman, greets speaker Morgan as Art Slemmons, program chairman, looks on.

STUNT PILOT AND RACING FLIER Paul Mantz (left) spoke on World War I aircraft in his talk "Heritage of the Air" at **San Diego Section** October 13.

The meeting also featured a series of newsreels from World War I including: Baron Manfred von Richtofen and his Flying Circus, the French "Stork" Squadron, and the American "Hat-In-The-Ring" Squadron.

25 and 35 year certificates

Edward Lowe (left), retired SAE West Coast manager, and J. P. Stewart (right), retired president, DeLaval Steam Turbine Co. in N. J., received certificates for 35 years in SAE from Chairman E. V. Ablert at SAN DIEGO October 13.

Joseph Liston (right), professor of Aeronautical Engineering at Purdue University, received a 25 year membership certificate from Chairman Melvin Estey at INDIANA SECTION'S October meeting.

William W. Churchill (right), regional manager of Western Greyhound Lines, received a certificate for 25 years membership in SAE from Chairman Otto Kirchner at NORTHWEST SECTION'S October meeting.

C. A. Dively (left) received a certificate commemorating 25 years membership in SAE from Chairman F. W. Finch at FORT WAYNE SECTION'S September meeting.

Alfred Bondi (left) and L. MacDonald Long (right) were presented with certificates for 25 years membership in SAE at MONTREAL SECTION'S October meeting.

Edwin L. Allen (left), engineer at Atwood Vacuum Machine Co., received a certificate for 35 years membership in SAE at ROCKFORD-BELOIT SECTION October 19. Admiring the certificate are Section Chairman W. C. Arnold and Secretary Edward Retzinger.

Erwin C. Horton (right), chief engineer at Trico Products Corp., received a certificate for 25 years membership from Chairman Churchill W. Bartlett (left) at BUFFALO SECTION October 29.

Certificates were presented at NORTHERN CALIFORNIA SECTION October 28 by Chairman M. H. Pomeroy (right) to (left to right) R. G. Hall for 25 years, C. F. Becker for 35 years, and F. G. Wildhagen for 25 years.

SAE's CEP News

COOPERATIVE ENGINEERING PROGRAM

SHAKE TABLES used to simulate vibrations encountered in aircraft and vehicle operation are demonstrated at Bostrom Research Laboratories to members of the SAE Riding Comfort Research Committee. The demonstration occurred during the Committee's September meeting in Milwaukee. Shown in driver's seat is Robert N. Janeway, Janeway Engineering Co. Standing from left are: Robert Bollinger, Ford Motor Co.; Howard Moos, Caterpillar Tractor Co.; Harold Brock, Ford Motor Co.; Gerald Hostetler, International Harvester Co.; and R. W. Clements, Bostrom Research Laboratories.

TCAR Focuses on New Tables and Machines

AMONG the items covered at an SAE-ASTM Technical Committee on Automotive Rubber meeting table in Detroit this fall were:

- Proposals for two new tables, one describing fluoroelastomers, the other urethane rubber.
- Two prototype machines, one for miniature impact testing, the other for bushing test purposes.
- Approval of a test method for accelerated ozone cracking of automotive compounds.

New Materials Tables

The fluoroelastomer table looks like it will be based on more than one type. This is due to differences found in the heat resistance of some fluoroelastomer products.

The urethane rubber table is being devised in response to a rapid increase in the use of such products.

The prototype miniature impact test machine now under development by the Mast Development Co. will first be used by the Enjay Co. Data resulting from these tests will then be correlated with the impact testing of full-size bumpers . . . the latter to be conducted by Ford.

The Enjay-Ford tests are expected to throw more light on whether miniature-size impact testing and full-scale impact testing can be correlated.

Three different qualities of rubber compound are scheduled to be used in these tests . . . high, medium, and low in 50 and 60 durometer hardnesses.

A standard bushing test machine which fixes the inner member and rotates the outer is being considered by one TCAR Subsection. Special provisions for dynamic modulus measurements will be made.

Static Exposure Tests

Approval of the ozone cracking test mentioned above brought about a proposal on combining this test method D-1171, D-1149, and D-518 into one specification.

Crane Test Codes A "First" for SAE

FOR the first time, test codes for *cranes* are being fostered by an SAE technical committee group. Currently on the roster of the new CIMTC Crane Testing Procedures Subcommittee, they cover crane lifting stability, travel speed, line speed and pull, loads on wire rope, and crane structure evaluation.

The Subcommittee hopes to complete these reports for the 1961 SAE Handbook, according to Chairman A. J. Rutherford, chief, Operational Test Branch, Army Engineer Research and Development Labs, Ft. Belvoir, Va.

Since September, the Subcommittee (which drew its original membership from former Defense Department Industry Advisory Committee) has held three meetings. Work is revolving around the establishment of objectives and actual performance requirements. For the time being, the five codes are slated to:

Crane Lifting Stability — Determine the combination of load and radius at which a specified tipping condition is induced in a crane. The test will be limited to cranes where tipping rather than strength of components is the determining factor.

Travel Speed — Determine the ability of a crane to travel under its own power on a level, hard-surfaced test course in a specified gear selection at a specified speed with specified mounted and/or trailed equipment. This code will apply to all full-revolving and semi-revolving crawler and pneumatic tire mounted crane-excavators.

Line Speed and Pull — Determine the ability of a machine to develop a specified line speed at a specified line pull or to develop a specified line pull at a specified line speed. Two optional methods of conducting this test are being considered:

- While hoisting a specified load, line speed is measured directly.
- Line speed determined indirectly from drum speed while hoisting a specified load.

Loads on Wire Rope — Determine

the load (in pounds) on crane-shovel wire rope as a means to relate the rope load to the rope strength. This test will apply to all crane-shovels.

Crane-Structure Evaluation — Determine stresses induced under load as a basis for judging the ability of mobile cranes to perform within the specified limits. The procedure involves:

- Locating areas of probable high stress by analysis and/or experiment.
- Checking the stress levels in these areas with a limited strain-measurement program.

Upon completion of the above, work on five other test codes will begin. These will cover travel shock and vibration, crane-swing performance, dynamic brake system fade, turning clearance, and fuel gage accuracy.

True Alignment of Axles, Rims Sought

ACCURATE methods of aligning . . .

- Trailer axles without disconnecting the power units, and
- Demountable rims on spoke wheels

. . . are being sought by the new Trailer Axles and Wheel Alignment Subcommittee of the Transportation and Maintenance Technical Committee. Once established, this information will be incorporated into a report destined for inclusion in the SAE Handbook.

Discussion of these subjects was opened at an October meeting in Chicago, according to Subcommittee Chairman W. F. Eaton, director of fleet maintenance, Mason and Dixon Lines. As a result, various designs for gauges that could be used by fleet maintenance personnel to check axle alignment are under investigation.

1960 SAE Handbook Bows in with New Year

THE 1960 SAE Handbook, with 18% of its technical reports either new or revised, represents the cumulative effort of SAE technical committees for 46 years. It's release on January 1, 1960 will directly or indirectly affect every ground, air, and space vehicle being built in America today.

Of the 375 reports in this 903-page volume, 16 are new, 67 revised, and 53 reaffirmed. Developed and up-dated by scores of technical committees in the SAE Technical Board structure, they provide dimensional specifications, test requirements and procedures, and material compositions.

Among the new reports in the 1960 Handbook are:

Truck Transmission Test Code . . . facilitates the comparison of truck transmissions by providing a series of tests for a transmission's range of operation. Also given in this Transmission Committee report is a method of recording data obtained from these tests.

Mechanical Power Outlet Test Code . . . measures the power take-off of tractors, graders, stationary powerplants, and other automotive vehicles. It assures greater accuracy and was developed by the Construction and Industrial Machinery Technical Committee.

Air Brake Reservoir Test Code and Inspection Procedure . . . sets forth a realistic test procedure for air brake reservoirs used in automotive applications. It was developed by the Brake Committee as the result of a request from the Automobile Manufacturers Association.

Motor Fuels . . . provides automotive engineers with information on the more pertinent characteristics of motor fuels. Also given are overall concepts of the significant properties of automotive gasolines. This Fuels and Lubricants Technical Committee report tells where the standard test methods needed to define or evaluate motor fuel characteristics may be found.

Synthetic Resin Plastic Sealers . . . applies to the nondrying, nonbleeding, and noncorrosive sealers that can be extruded to a specified size and used as a medium for producing a water tight seal between two pressed steel sections or between rubber and steel. The specifications and test methods in this new SAE Recommended Practice were devised by the SAE Nonmetallic Materials Committee.

Light Output Meters . . . describes a laboratory test procedure for light output meters to determine their ability to measure the light output of headlamps, fog lamps, and auxiliary driving and passing lamps, within prescribed tolerances. This new recommended practice was developed by the SAE Lighting Committee.

Agricultural Tractor Tire Loading and Inflation Pressure . . . supplements the Tractor Test Code by establishing loading and inflation pressure relationship for sizes and ply ratings used on agricultural tractors.

Equipment Expert Joins Automotive Council

MERRILL R. BENNETT, engineering manager of International Harvester's Construction Equipment Division, has joined the Technical Board's Automotive Council at the behest of Council Chairman George J. Huebner, Jr.

The core of his engineering experience lies in the construction equipment field. Prior to joining IHC 25 years ago, Bennett received a master's degree in engineering at Purdue. In 1948, he obtained a business administration degree from the University of Chicago.

He emerged as a prominent SAE member when he became chairman of the Chicago Section in 1953, Vice President for the Diesel Engine Activity in 1957, and a member of several technical committees.

Bennett's appointment to the Automotive Council will bring him in close contact with 16 SAE technical committees. Along with other Council members, he will review new, revised, and reaffirmed reports prior to their dissemination through SAE publication channels.

Bennett

CRC

STEADY ACCELERATION of research programs in the automotive, diesel, and aircraft fields is revealed in the 1959 Annual Report of the Coordinating Research Council, Inc. Notable is another climb in work done for the military, which now stands at approximately 50% of the CRC total . . . as compared to the 40% mark about which the military proportion has pivoted in recent years.

Currently, 35 projects are in the CRC technical committee mill. During the past year, five new projects were undertaken and 10 were completed.

Jointly sustained by SAE and American Petroleum Institute, CRC technical work is set up on an industry rather than a product basis. Its three main technical committees:

- Indicate the emphasis to be placed on various subjects.
- Control the speed with which projects are executed.
- Review reports emanating from the groups under them.

The work done by these three committees — Aviation, Diesel, and Motor — is detailed in the Annual Report. Highlights of the work are summarized in following paragraphs.

CRC — Aviation Committee

Electrostatic Discharges in Aircraft Fuel Systems — To determine factors controlling the build-up of electrical discharges within aircraft fuel systems, a program was set up which utilized a simulated full-scale aircraft fuel system. Results of tests conducted at Wright Air Development Center indicate that despite evidences of danger, the *degree of hazard* remains unknown. Because more data is needed, a recommendation was made to turn the program over to an outside agency where work could be carried out under the guidance of a CRC Advisory Group.

Thermal Stability of Aviation Turbine Fuels — Practical laboratory techniques for predicting thermal stability characteristics of liquid petroleum hydrocarbon fuels are being sought. This project results from an industry need to know more about fuels for supersonic aircraft and certain types of missiles.

Measuring Flame Radiation of Turbine Fuels and its Effect on Liner Temperature and Smoke — A limited program to develop a technique for measuring flame radiation of turbine fuels and its effect on liner temperature and smoke shows that:

- If there is interest in fuels of higher than 100 Luminometer Number, more tests should be made on fuels having higher than 100 Luminometer Number to firmly establish the reproducibility and repeatability of the test in this range.
- A study should be made of the effect of variations in atmospheric conditions upon Luminometer Number. A correction method for these variations should also be developed.

Properties of Aviation Fuels, Lubricants, and Systems — Compiling information on properties of aviation fuels, lubricants, and systems is being attempted due to interest expressed by the aviation industry. Negotiations are currently underway to secure financial assistance from the Military Services. Information would be compiled by a contractor with CRC advice and assistance to insure the inclusion of the material required by industry.

Lubricants — To cope with high-temperatures and more severe conditions imposed by supersonic aircraft and missiles, techniques are being developed to:

- Predict high-temperature performance of lubricants for ball and roller bearings used in airframes.
- Measure the effect of airframe and accessory lubricants to minimize fret corrosion in the equipment in which they are used.
- Evaluate the performance of greases under slow, high-temperature, highly-loaded, and sliding motion.
- Study bonded solid lubricant coatings.

CRC Diesel Committee

Ignition Quality of Diesel Fuels — Expanded to include work on residual and heavy types of fuels as well as the higher fuels such as gasoline, this project is of interest in view of increased military activity on the multi-fuel concept.

The Committee is also working on low-temperatures, since it appears that the cetane number is a good indication of ability to start at low temperatures, but may not be a good indication of low-temperature and part-load operation.

Diesel Engine Rating Manual — With CRC-Diesel Committee guidance, a Diesel Engine Rating Manual has been prepared to serve as a reference volume incorporating a standardized system for rating diesel engines for deposits and wear. The purpose of the Manual is to define inspection techniques. In addition, it contains descriptions of rating techniques applicable to specific engine parts or detailed areas of a part under consideration.

Railroad Engines and Their Lubrication — A survey of problems encountered with railroad engines and their lubricants is being made. Replies received to a questionnaire circulated to railroads, engine builders, lubricating oil companies and additive producers, indicate that:

(1) No single test or series of laboratory tests can predict the service level of a railroad lubricating oil.

(2) A variety of tests are now being used which seem to be capable of screening oil for use in the development of oils preparatory to full-scale field service testing.

(3) A general feeling exists that some of the tests are more significant than others for evaluating oils.

(4) The final answer for the utility of a lubricating oil will come as a result of full-scale service tests.

Smokemeters — Instrumentation and techniques for evaluating smoke from diesel engines in the laboratory are being refined by the Smokemeter Group.

CRC — Motor Committee

Exhaust Gases — The CRC-Motor Committee is seeking a complete calibration of the detector used in the technique for continuous determination of total hydrocarbons in exhaust gases. Further revision and study of the sampling system continues.

The objective of the work with continuous hydrocarbon analyzers is to develop techniques for operation, adjustment and calibration of instruments so that they yield reproducible results that are consistently related to the total carbon content of hydrocarbon emissions.

If satisfactory instrumentation can be developed, another survey of exhaust gas emissions may be conducted next summer.

Analyzing Oxygenated Materials — Chromatographic investigations conducted for the CRC under contract at the Bureau of Mines have been completed. Major emphasis was placed on the development of chromatographic techniques for analyzing oxygenated materials. These techniques, when used in connection with investigations sponsored at the Bureau of the U. S. Public Health Service, indicated that qualitative information could not yet be reported. A summary report covering the Bureau's investigations will be released soon.

Vapor Lock — Vapor lock work revolves around the development of:

- A technique to survey the vapor-handling characteristics of current automobiles.
- A better expression for measuring vapor-lock than Reid vapor pressure at 100 F.

A detailed program was carried out in 1958 to study vapor lock, hot starting and stalling. Tests were run on six fully-instrumented automobiles at the Ford Proving Ground, Kingman, Ariz., with 27 companies, including a British petroleum company, participating. Concurrent runs on a chassis dynamometer indicated that it was possible to obtain a good correlation with road test results.

Octane Number Requirements — The

1959 octane number requirement survey will be conducted on a nation-wide basis. A total of 562 cars will be tested, 402 of which will be used in a statistical survey of 1959 model cars and 160 of which will be selected models of special interest. Determination of octane requirement data over the operating speed range will be made, as well as the maximum octane number requirement of the vehicle.

Rumble, the effects of part-throttle operation, and information on additional throttle openings obtainable in passing gears (in some cars) will also be indicated.

Knock Tests — The interrelationship of the ratings from various laboratory knock test techniques and knock performance of full-scale vehicles is still under study. Also under investigation is the significance of surface ignition, and the combustion-chamber deposit and user relationship to various erratic combustion phenomena.

A program on road knock ratings to evaluate the knock ratings of premium quality fuels in 1959 model cars has been planned, primarily to investigate the effects of throttle positions on fuel ratings as well as the rumble tendencies of these fuels and engines. Work on laboratory knock ratings is being closely coordinated with the work of ASTM Research Division 1 on improvement of repeatability and reproducibility of the current laboratory test methods.

Measurement of Instantaneous Combustion — Two independent means of measuring engine unburned-gas temperature have been developed . . . a velocity-of-sound technique at MIT and an infrared emission-absorption technique at the University of Wisconsin. The precision and accuracy of these techniques have been demonstrated, and a series of comparison tests in which both methods were used simultaneously on the same engine gave entirely satisfactory results. Proposals for further study (under CRC direction) of equipment developed at the two institutions have been submitted to the petroleum and automotive industries.

Seal Performance — Development of tests for predicting functional seal performance in actual operation is the objective of the seal project. Work has been divided into two phases, fuels and lubricants. Information is also being secured on the problems involved with performance of seals in axles and transmissions in the presence of lubricants, and in fuel systems and fuel dispensing systems in the presence of fuels.

CRL Oil Test Engine — A comprehensive test program using the CLR Oil Test Engine was aimed at:

- Improving repeatability and reproducibility of the Research Technique for Study of the Oxidation Characteristics of Crankcase Oils in the CLR Oil Test Engine (CRC Designation L-38).

- Evaluating the various possibilities for future adjustments in severity.

Completion of this program concludes the first phase of work on the development of a suitable oil oxidation test (which has been officially accepted by the Ordnance Corps and issued as a tentative Military Specification). The next phase will cover refinements in the engine and the technique.

The CLR Oil Test Engine is also being used to evaluate the varnish and sludge-formation characteristics of lubricating oils. An investigation of low temperature sludge is now in progress.

Gear Lubricant Evaluation — In response to urgent Military requirements, the Gear Lubricants Group recently completed the development of a series of gear lubricant evaluation techniques. These techniques will be included as part of the new multi-purpose gear lubricant specification (MIL-L-2105A).

The Ordnance lubricant performance investigations will continue to cover inspections and recommendations relating to the lubrication of the Ordnance air-cooled gasoline engine and the water-cooled multi-fuel engine.

Transmission Fluids — Investigation of the interrelationship of power-transmission and power-steering units and their fluids is actively being pursued. The Group is also assisting the Ordnance Corps in a study to determine the suitability of military engine oils as transmission fluids for military vehicles.

A Guidance for Ordnance Materiel Designers — At the request of the Office of the Chief of Ordnance, a special CRC Group was set up to prepare a booklet to assist the designers of Ordnance materiel in understanding some of the problems involved in the mutual adaptation of fuels, lubricants, and the equipment in which they are used. A report is to be officially transmitted to the Military during 1959.

Coordinated Projects

Studies of storage stability of motor gasolines, jet, and diesel fuels are being coordinated by the CRC Coordination Committee since they do not fall within the specific scope of existing technical committees.

Work on the gasoline storage stability project consists primarily of a long-range fundamental study of gum formation. The program is being executed by the U. S. Bureau of Mines and the Stanford Research Institute.

Report for '59 Marks Speed-up in CRC Research Programs

SAE MEMBERS

JOHN L. COOLEY has retired as vice-president and director of California Research Corp. after 39 years association with Standard Oil Co. of California and its subsidiaries. Cooley joined the manufacturing department of Standard at Richmond in 1920 and held a series of posts in manufacturing and research before becoming vice-president of California Research in 1947.

Cooley has been active in government advisory and industry groups such as the National Advisory Committee for Aeronautics, the Combustions Institute and the Coordinating Research Council. After visiting their son in Conn. Cooley and his wife will return to their home in Walnut Creek, Calif. They are planning occasional travel, both foreign and domestic.

DR. AUGUSTUS B. KINZEL, vice-president in charge of research for Union Carbide Corp., has been named recipient of the Industrial Research Institute Medal for 1960. The medal has been awarded annually since 1945 to honor "outstanding accomplishment in leadership in or management of industrial research."

Dr. Kinzel, who has had more than 40 patents issued in his name, pioneered in the theory of stainless steels. His work on deoxidizing and alloying elements pioneered the structural low-alloy steels and the new ferroalloys and provided major advances in the welding and cutting of steel. He also spearheaded the research that led to the development of Union Carbide's process for making titanium metal.

REGINALD C. WHITSON has been named marketing manager for Houghton Laboratories, Inc. Formerly he was manager of Government Projects Division of Warner Electric Brake & Clutch Co.

J. R. MacGREGOR has been elected vice-president and director of California Research Corp., in charge of petroleum products research. He succeeds **John L. Cooley.**

MacGregor joined the research and development department of Standard Oil Co. of California at Richmond in 1925 and held a series of positions concerned with the development and evaluation of automotive and industrial fuels and lubricants. In 1938 he was assigned to San Francisco office as technical staff consultant to the management. He was transferred to California Research at the time of its organization in 1944. MacGregor was SAE vice-president representing F&L Activity in 1948 and will be a member of the SAE Board of Directors in 1960.

W. H. WORTHINGTON, who for many years has been director of research for the John Deere Tractor Research & Engineering Center, Deere Mfg. Co., in Waterloo, Iowa, has been made director of all engineering for the two plants of the company's German subsidiary, Heinrich Lanz, A. G. of Mannheim, Western Germany. He sailed November 6 on the S. S. United States to take up his new duties in Germany.

WILLIAM L. BARTH, retired head of engineering standards section of General Motors Corp. and executive secretary of its standards committee, received the Standards Medal for service to the voluntary standards movement through leadership in the actual development of standards. The medal was presented Oct. 21 by the American Standards Association in conjunction with the Tenth National Conference on Standards.

Barth formerly represented the Automobile Manufacturers Association on the Mechanical Standards Board of ASA. He has served on various subcommittees of ASA, often as a representative for SAE. He was also an advisor to the American-British-Canadian Conferences on the Unification of Engineering Standards.

BENARD L. MAAS, SR., formerly sales manager of Broderick Forge Co., has become president of the newly formed Cold Forged Products Co. Maas was one of the original organizers of Federal Screw Works in 1918 and has been active in various automotive parts manufacturing industries. In addition to his official capacity, he will devote his time to promotion of the company's product and will serve in an advisory capacity.

Cooley

MacGregor

Worthington

Barth

MAURICE A. THORNE has just retired after 25 years of service with the General Motors Corp. For a decade, Thorne has been engineer in charge, Vehicle Development, GM Engineering Staff.

A graduate of George Washington University, his engineering career began at the National Bureau of Standards. Subsequently, it took him to Studebaker, Pierce Arrow, Oldsmobile, and finally to GM's Engineering Staff.

Through the years he has been active in SAE in many capacities. Currently he is serving as chairman of SAE Overseas Information Committee. He was chairman of SAE Buffalo Section, chairman of SAE Public Relations Committee, served on several technical committees during World War II, and has presented a number of papers before SAE audiences.

Throughout his engineering career, Thorne has been a student and collector of traditional furniture. He plans to set up Westmoreland Reproductions to engage in the manufacture, on a limited scale, of selected designs. The furniture venture will be installed near his new home at Tucker Hill, Westmoreland County, Vir.

L. EUGENE ROOT has been named to the newly created position of group vice-president at Lockheed Aircraft Corp. In this position Root will be responsible for Lockheed's Missiles and Space Division and the company's newly formed Electronics and Avionics Division. He will also be in charge of Stavid Engineering, Inc., providing stockholders approve the move to make the company a subsidiary of Lockheed. As corporate vice-president Root will be headquartered in Burbank, Calif.

Root was named Lockheed vice-president and general manager of the Missiles and Space Division in 1956. He joined the company in 1953 after 20 years' experience with Douglas Aircraft, RAND Corp., special assignments with the U. S. Air Force and Department of Defense, and membership on various scientific committees.

NEIL D. ELY has retired as president of Young Spring & Wire Corp., after serving the company for 35 years. He will continue to serve as a member of the board and its executive committee. Ely plans to devote most of his time to the operation of his Hilltop Farm in Metamora, Mich.

LOTHROP M. FORBUSH succeeds **Maurice A. Thorne** as engineer in charge of Vehicle Development Group at General Motors Corp. Formerly a design engineer for United Shoe Machinery, he served with the U. S. Coast Guard from 1943 to 1946. In 1946 he joined GM Engineering Staff's Structure and Suspension Development Group. In 1951 he transferred to Vehicle Development where he became assistant engineer in charge of the group in 1957.

THOMAS SCOTT succeeds **Lothrop M. Forbush** as assistant engineer in charge of Vehicle Development Group for General Motors Corp. Scott was employed by Westinghouse Electric Corp., Dodge and Hupmobile motorcar companies before joining GM Engineering Staff in 1935. Later he was on the engineering staffs of Chevrolet and Fisher Body Divisions before returning to GM Engineering Staff in 1948.

FRANCIS M. COFFEY, JR. succeeds **Thomas Scott** as engineer in charge of automotive ordnance section of General Motor Corp.'s Vehicle Development Group. Coffey joined GM Engineering Staff as design engineer in 1954. He graduated from George Washington University in 1949 and received his masters degree from Wayne State University in 1959.

MAURICE J. DAY, formerly vice-president, technology for Crucible Steel Co. of America, has been appointed to the newly created position of vice-president, commercial. The position was created in connection with an expansion of Crucible's sales organization. Day will have full responsibility for sales management in the company.

Day began his career as metallurgist for Carnegie-Illinois Steel Corp. (now part of United States Steel Corp.) Subsequently he served them as technical trade representative, physical chemist in research, manager of Alloy Division, and assistant metallurgical engineer for alloy steels.

THOMAS B. CHACE has been appointed to the newly created position of executive vice-president of Dole Valve Co. Chace joined Dole in 1927 and has served as vice-president in charge of development since 1941. He was elected to the board of directors in 1954.

H. A. MAYOR, JR., executive vice-president of Southwest Grease & Oil Co., Inc., has been elected president of the National Lubricating Grease Institute. He has been a director of NLGI since 1953 and has chairmanned a number of important committees. This past year he served as the Institute's vice-president and program chairman.

C. L. JOHNSON, president of Jesco Lubricants Co., has been named secretary of National Lubricating Grease Institute. He has served on the board since 1953.

A. J. DANIEL, president of Battenfield Grease & Oil Corp., is to serve his eighth consecutive term as treasurer of National Lubricating Grease Institute. He was president of the Institute in 1949 and has been a director since 1945.

SAE members elected to three year terms as members of NLGI's board of directors are: **T. W. BINFORD**, president of D-A Lubricant Co., Inc.; **G. E. MERKLE**, president of Fiske Brothers Refining Co.; **F. W. MINOR**, manager of technical services for Sinclair Co.; and **W. M. MURRAY**, vice-president in charge of general sales at Keer-McGee Oil Industries, Inc.

GEORGE L. McCAIN, retired research engineer for Chrysler Corp., **FRANK R. L. DALEY**, staff engineer for Buick Motor Division of General Motors Corp, and **CARROLL R. ALDEN**, professor of electrical engineering at Ohio Northern University, were contributors to the completely revised "Tool Engineers Handbook," Second Edition. The Handbook is a technical reference work published by the American Society of Tool Engineers.

LAURENCE M. LIMBACH has been named corporate director of manufacturing for Aerojet-General Corp. Formerly he was vice-president and general manager of Defense and Technical Products Division of Rheem Mfg. Co. He was chairman of SAE San Diego Section in 1956.

BRUCE A. WILLSEY has become vice-president in charge of manufacturing for Solar Aircraft Co. Previously he was vice-president and general manager of their Des Moines Plant. Willsey was a member of SAE Executive Advisory Board for Production Forum in 1953–1954 and was general chairman of the Forum in 1955.

continued


Thorne


Root


Ely


Forbush


Scott


Chace

SAE Members

— continued —

JAMES D. REDDING has been named director of military applications of Remington Rand Univac. In his new position, Redding will be responsible for all military marketing and applications, with headquarters in Washington, D. C. The existing military contract administration and customer representative groups in St. Paul, Minn., Washington, D. C., Dayton, Ohio, and on the West Coast will report to Redding.

Redding joins Remington Rand Univac after five years with Westinghouse Electric Corp. as marketing manager of the Aviation Gas Turbine Division. Prior to that, he was technical assistant to the assistant secretary of defense, research and development, and for several years was manager of the Aeronautical Department of SAE.

P. G. WARE has been appointed chief executive engineer and a member of the board of directors of Humber, Ltd. in Coventry, England. Previously he was chief electrical engineer at C. A. V., Ltd. in London.

RICHARD G. BOWMAN has been appointed technical assistant to the president of Republic Aviation Corp. Bowman joined Republic in 1935 and has served them in a number of executive engineering posts. Among other professional distinctions he was selected as a member of the U. S. Air Force Industry and Educational Advisory Board.

NOEL S. SEIGEL has been appointed assistant to the president of New England Instrument Co. In this position he will be concerned with corporate administration, general operations and overall planning for the company. Previously he was marketing staff assistant at Barry Controls, Inc.

ARTHUR F. PELSTER has been named vice-president in charge of sales for Avtron Mfg., Inc. Previously Pelster was vice-president in charge of aircraft product sales for Leland Electric Co.

ERIC G. BOEHM has been appointed general manager of the Manzel Division in Buffalo, N. Y. of Houdaille Industries, Inc. Boehm has been associated with Houdaille for more than twenty years and most recently served them as general manager of Buffalo Bolt Division.

EDWIN E. DATO has become vice-president and secretary of Dato & Co. Previously he was design engineer for General Dynamics Corp.

CHARLES H. McDONNELL is now project engineer at Allis-Chalmers Mfg. Co., Nuclear Power Department. Previously, when ACF Industries, Inc. owned this division, McDonnell served ACF in a similar capacity.

SIR JOHN PASCOE has been elected a director of Timken Roller Bearing Co. Pascoe joined British Timken, Ltd. as financial director and member of the board of directors in 1930. He was appointed managing director in 1943 and board chairman in 1950. In addition to his service on the board of Timken, he will continue as chairman of the board of the British Timken Division.

PALMER NICHOLLS, who has served Bendix Aviation Corp. for 30 years, is retiring as group executive at his own request for reasons of health. He will remain with the company on a part-time basis as a member of President **Malcolm Ferguson's** administrative staff. He will specialize in diversification studies and negotiations on the West Coast, with a new office being established for that purpose.

HOWARD A. ALEXANDERSON has been named director of engineering at the Utica Division of Bendix Aviation Corp. Alexanderson joined Bendix 25 years ago and has served them as chief engineer of the Utica Division since 1951.

DONALD M. ROSS has become assistant chief, rocket propulsion at the Development Division of the Air Force Flight Test Center at Edward Air Force Base in Calif. Previously he was chief, operation office for the Propulsion Laboratory at Wright Air Development Center, Wright Patterson Air Force Base in Ohio.

EMERSON W. CONLON has been named assistant director of aeronautical and space research for the National Aeronautics & Space Administration. He is on a leave of absence as director of research at Drexel Institute of Technology.

After 12 years in private engineering, Conlon joined the University of Michigan's Aeronautical Engineering Department in 1937, later becoming chairman of the department. Conlon has served the Navy Bureau of Aeronautics, directing development of Douglas D-558, the Navy transonic research plane, and has served the Air Force as technical director of its Arnold Engineering Development Center. In 1953 he joined Fairchild Engine Division. Prior to becoming research director at Drexel in 1958, he was general manager of Turbomotor Division, Curtiss-Wright Corp.

SMITH BOLTON, divisional president and general manager of U. S. Graphite Co., has been elected vice-president of the Powder Metallurgy Parts Manufacturers Association. Previously he was treasurer of the association.

HAROLD T. GLENN has recently had his book "Automobile Power Accessories" published. The book was written for vocational-technical students and mechanics and provides guidance in the understanding of power accessories.

Glenn has spent 8 years in the automobile trade, some of this time as an automotive machinist. He taught automechanics for 13 years on both an industrial and vocational basis, and is presently instructor in Automechanics at Charles Evans High School, Long Beach, Calif. He is also author of "Automobile Engine Rebuilding and Maintenance," "How to Locate Automobile Troubles," "Exploring Automechanics," and "Youth at the Wheel."

PARRY BARNES has been named sales development manager for Construction Machinery Division of Clark Equipment Co. Previously he was sales training manager.

WARREN A. BROWN, previously manager of lubricant sales and technical services, is now manager of marketing administration for Champlin Oil & Refining Co.

Redding

Ware

Bowman

Seigel

Pelster

Boehm

DERWYN MARLAND SEVERY, an associate research engineer at the University of California, was named recipient of the Society of Motion Picture and Television Engineers' Journal Award for the most outstanding paper originally published in SMPTE Journal during 1958. Severy received the award for his paper "Photographic Instrumentation for Collision Injury Research" at the 86th semi-annual convention of the Society held October 5–9.

I. F. RICHARDSON has become assistant manager of Hughes Products Division of Hughes Aircraft Co. Previously he was general manager of Kansas City Division of Bendix Aviation Corp.

O. S. PERKINS has been appointed chief engineer for Hydraulic Machinery Co. Perkins began his career as a hydro electric specialist at Amberson Engineering Co. Subsequently he joined Abner Doble Co. as steam power plant consultant, and prior to his recent appointment he was engineer in charge of hydraulic cranes and excavators for Bucyrus-Erie Co.

SCOTT H. HANVILLE, JR. has been named manager of aviation sales and application engineering at Jack & Heintz, Inc. In his new capacity, Hanville adds the duties of sales manager for aircraft and missile products to his function as manager of application engineering, a newly-established post when he assumed it a year ago. Hanville joined Jack & Heintz in 1954 as application engineer. During World War II he was Lieutenant in the Navy, assigned to electronics, and later headed the aircraft power section of Navy Bureau of Aeronautics. He is a former engineering vice-president of Royal Electric Corp.

RICHARD C. LEWIS has been appointed district sales manager of mobile products for the New York-Worcester-Philadelphia area of Vickers, Inc. His headquarters are in Springfield, N. J. where he has been working as application engineer. Lewis joined Vickers's sales department in 1953. He was on special assignment as an administrative assistant to mobile products sales manager in Detroit before going to Springfield in 1956.

WILLIAM DUNCAN has been appointed sales manager, original equipment manufacturers for the Automotive Division of Electric Storage Battery Co. Duncan joined the company in 1949 as a member of their Exide Replacement field sales force. In 1952 he became an O. E. M. representative in Detroit, where he will retain his headquarters.

LAWRENCE H. HODGES, formerly manager of Rockford Works for J. I. Case Co., is now director of product engineering for the company's Agricultural Division. Hodges has served on SAE FCIM Activity Committee.

CARROLL J. LUCIA has been appointed president and chief engineer of Deltadynamics, Inc., a new company specializing in automotive quality testing equipment and technology with headquarters at Green Bay, Wis. Previously Lucia was chief engineer in charge of industrial products for Dura Corp.

THOMAS COUPER, vice-president and director of Young Spring & Wire Corp., has been appointed general manager of the company's newly formed automotive division. He will devote his time exclusively to managing the automotive division and will be headquartered in Detroit.

S. G. OLLING has retired after 27 years with Seiberling Rubber Co. Olling has served the rubber industry since 1916 and was most recently Midwestern representative for Seiberling's manufacturers sales department.

PHILLIP H. MAXWELL has been named sales manager of Automotive Division of Kelsey-Hayes Co. He has served Kelsey-Hayes since 1942 except for a period of service as naval aviator during World War II. Most recently he was assistant sales manager.

JOHN F. SIEBERTH, formerly patent attorney for Ethyl Corp., is now manager of their Baton Rouge Patent Section.

JEFFREY L. WEST, formerly mechanical engineer for Microtech Research Co., is now new products engineer at Resistoflex Corp.

B. THOMAS HORACE, formerly aeronautical research engineer for the Army Ballistic Missile Agency at Huntsville, Ala., is now aeronautical engineer for the Department of the Army's Transportation Supply & Maintenance Command at St. Louis.

HENRY JENNINGS, senior automotive engineer on the staff of Anthony B. Cassedy & Associates of Westport, Conn., will contribute to Eastman Motor Truck News, as a consulting editor. One of his first assignments for the publication will be a series of articles dealing with truck maintenance.

NORMAN C. SCHUMACHER has been appointed sales supervisor, petroleum additives for Amoco Chemicals Corp. Schumacher joined Amoco Chemicals in 1957 as sales engineer, petroleum additives, after six years with Standard Oil Co. Prior to joining Standard Oil he served Electrical Engineering and Equipment Co.

D. C. GASKIN, Mack Trucks of Canada's executive vice president, is also a member of the Board of Governors of McMaster University, Hamilton, Canada. Gaskin finds that good use is made of his back copies of SAE Transactions and previous year's Handbook in the University's library, as well as his copy of SAE Journal — which he sends each month after reading.

CHARLES T. MOLLOY has been named head of Titan Airframe Section for Space Technology Laboratories. Formerly he served Lockheed Aircraft Corp. as staff engineer for Sound & Vibration. For the past year Molloy taught a graduate course entitled "Engineering Acoustic" at the Mechanical Engineering Department of University of Southern California and is scheduled to repeat the course evenings during 1959–1960. He also plans to teach "Application of the Method of Four Pole Parameters to Physical Problems" at UCLA.

Molloy has been chairman of SAE G5 Committee on Aircraft and Missile Shock and Vibration since 1955, and has been active in the organization of the Shock and Vibration sessions of SAE National Aeronautic meeting since 1957.

continued


Severy


Richardson


Perkins


Hanville


Lewis


Duncan

SAE Members

— continued —

EDMOND H. JUDD has been appointed factory manager of Gibson Division of Associated Spring Corp. Previously he was in charge of Flat Department tooling at Wallace Barnes Division of Associated Spring Corp. Prior to that he was product engineer at the Wallace Barnes Division.

COL. WILLARD F. ROCKWELL, chairman of the board of Rockwell Mfg. Co., recently received a Freedoms Foundation "Honor Certificate Award" for outstanding speeches and writings in the economic education field.

JOHN H. FELLOWS has become sales promotion manager for Industrial Division, Timken Roller Bearing Co. Previously he was district manager in Boston for Timken.

LEIGH J. ABELL has joined the special projects department at Fab Mfg. Co. Previously he was automotive engineer for Pacific Gas & Electric Co.

JOSEPH DeTILLA has joined J. V. Baldwin Motor Co. In his new position he expedites the servicing and equiping of new cars for delivery to the buyer. Previously he was inspector of automotive equipment for the State of California, Department of Finance, Automotive Management Section.

L. R. THOMPSON, previously California state director of the Available Garage plan, is now owner of L. R. Tommy Thompson, an adjusting and appraising office in San Francisco.

FERGUSON J. BYARS, previously senior sales engineer for Hamilton Standard Division, United Aircraft Corp., has joined Industrial Products Division of I. T. & T. as field engineering representative for eastern region with headquarters in Manchester, Conn.

ROBERT T. KOCH, formerly a student at Parks College of Aernautical Technology, is now a field service representative for Lycoming Gas Turbine Division of AVCO Corp.

Judd

CLIFFORD R. FEILER has joined the Hazell Machine Co. in St. Louis as chief engineer. Previously he was new product development engineer at Pandjiris Weldment Co. Feiler is a past chairman of SAE St. Louis Section.

ALFRED BOTTI, previously chief engineer for the Cable Division of C. M. Hall Lamp Co., is now plant manager and chief engineer at Flexible Controls Corp.

JOHN H. TANZER, formerly assistant chief engineer for Fruehauf Trailer Co. of Canada, Ltd., has become development engineer at Garwood Industries, Inc.

F. C. RUSSELL, owner of the Russell Service in West Hartford, Conn., recently had his latest Car Care book published.

RENSO J. VANNELLI has joined the Flight Propulsion Division of General Electric Co. as a specialist for J-79 project, engine system design. Previously he was manager of applications engineering for Utica Division of Curtiss-Wright Corp.

R. A. PAULSEN, previously sales coordinator for the New York office of E. I. du Pont de Nemours & Co., Inc., is now account manager at their Houston, Tex. office.

DEREK WHEELER has become application engineer for The White Motor Co. in Cleveland. Previously he was technical representative with The White Motor Co. of Canada, Ltd.

OHANNES SAMUEL has become assistant design engineer for Detroit Controls Division of American Standard. Previously he was design engineer at Giffels & Rossetti Architects-Engineers.

ROBERT L. JENKINS has become regional manufacturing specialist at Chrysler International, S. A. in Havana, Cuba. Previously he served Chrysler Export Division, Chrysler Corp. as staff executive, manufacturing.

GEORGE A. SEIPP, formerly chief engineer at Fred-Tex Machine, Inc., is now design engineer for Kittell-Lacy, Inc.

PATRICK J. McGRATH, JR., formerly an engineer for the Denver Division of The Martin Co., is presently studying at the Northrop Institute of Technology.

JOSEPH S. CASCIO has joined the U. S. Navy Department as general engineer for the Bureau of Weapons. In this capacity he is concerned with the safety aspects of missile weapons systems. Formerly he was associate editor of Diesel Publications, Inc.

HARVEY ALLEN HEDLUND has joined Michigan Bell Telephone Co. as motor equipment foreman. Previously he was mechanical engineer for the U. S. Army Signal Research and Development Laboratories at Fort Monmouth in N. J.

HERBERT R. FORTGANG has become chief engineer for Hindustan Motors, Ltd. in West Bengal, India. Previously he was manager of Product Study Vehicles Department at Ford Motor Co.

FRANCIS J. BOYLE has become assistant senior engineer for Kansas City Division of Bendix Aviation Corp. Previously he was administrative engineer at Bryant Chucking Grinder Co.

ROBERT B. OETTING has joined the University of Maryland as an instructor in Mechanical Engineering. Previously he was at Missouri School of Mines in a similar capacity.

ROBERT R. JAMESON has joined the Chevrolet Motor Division of General Motors Corp. as assistant material [illegible] inspector. Previously he was employed by Plains Chevrolet Co. as service engineer.

W. W. HOLT, previously lube engineer, is now chief plant co-ordinator lube supply for American Oil Co.

CHARLES J. WEBER has joined Chrysler Corp.'s engineering specialty group on a special assignment. Previously he was manager of product engineering for Industrias Kaiser Argentina S. A.

JOHN L. KING, formerly design analyst, is now product development engineer for Ford Motor Co.

ROBERT J. SCHROEDER has joined the Denver Division of The Martin Co. as mechanical engineer (classified). Previously he served the Pioneer-Central Division of Bendix Aviation Corp. as an engineering administrator.

FRANK T. SISCO has retired as director of the Engineering Foundation, although he retains his position as director of Alloys of Iron Research.

LOUIS GRABILL, formerly project engineer with J. I. Case Co., has joined Jered Industries, Inc. as analytical engineer. Grabill is chairman of SAE Fort Wayne Section.

P. R. VOGT, formerly assistant chief engineer, has been named chief engineer of liquid propellant engines for Rocketdyne Division of North American Aviation, Inc.

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1960 Engineering Graduates . . .

. . . who want to work in the industries served by the Society of Automotive Engineers, Inc.

For complete address, write: SAE Placement Service
485 Lexington Avenue
New York 17, N. Y.

Telephone:
OXford 7-3340

Preferred Location	Name, Degree, and Date Available	School and Field of Interest
		AERONAUTICAL UNIVERSITY
Midwest or West Coast	W. C. Sloup Assoc. B.S. — Sept.	Desire connection leading to position in aero. engrg. design. Presently employed part time as a draftsman.
		BRADLEY UNIVERSITY
Open	R. R. Pfeffinger BSME — Feb.	Prefer employment as sales or service engr. 2 yr experience as research technician in earthmoving industry.
Any	W. J. Storey BSME — Feb.	Seek job in machine design. Have experience in tool design and some light machine design.
		UNIVERSITY OF BRITISH COLUMBIA
Canada	H. G. A. Copping BASc — May	Prefer a job leading to work in design engrg. Taking a metallurgy option with mechanical engrg.
British Columbia	Gerard Doeksen BAS — May	Desire job with railroad co. in diesel power dept. Eventual possibilities in design and research preferred. Have made some personal investigation into wheel slip problems.
Western Canada	H. E. Fandrich BASc — May	Desire work in mechanical engrg. preferably in service & maintenance of prime movers — diesel, gas, or steam engines, or gas, steam, or hydraulic turbines.
		UNIVERSITY OF BUFFALO
Open	M. D. Tanis BSME — immediately	Desire research and/or design work requiring imagination. 1 yr experience as experimental technician with miniature oxygen regulators.
		CALIFORNIA INSTITUTE OF TECHNOLOGY
West Coast	T. H. Tebben BS — June	Prefer a position which allows utilization of chemical background and opportunity to move into management.
Open	D. R. McLane BSME — June	Desire temporary job providing mech. engrg. experience during interim between graduation and call to active duty as officer in USAF. Have a little design experience and a desire to eventually get into admin. engrg.
So. Calif.	Bruce Eglinton BSME — June	Interested in design work in field of rocket engrg. 3 summers experience with California State Dept. of Water Resources. 2 in field work and 1 in the mech. design section.
		CALIFORNIA STATE POLYTECHNIC COLLEGE
San Francisco or Los Angeles	A. P. Shadbourne BSME — June	Desire job involving design or research, dealing preferably with machine design, thermodynamics, or fluid mechanics.
West Coast	C. L. Williams BS — July	Desire position utilizing practical mech. engrg. training with possible specialization in design.
West Coast, San Francisco, or North	D. M. Bosworth BSME — July	Seek work which would lead to the position of design in machine work.
U. S.	R. L. Holladay BSME — June '59	Desire job in research and development—have held summer job in development lab.
Open	P. N. Price BSME — July	Desire work leading to coordinating or administrative engrg. 3 yr previous experience in field. Currently chairman, SAE Student Branch.
Los Angeles area	J. J. Tiedemann, Jr. BSME — July	Graduated with AAS in Air Conditioning, Heating & Refrigeration, 1957. Will graduate 1960 with BSME; worked for Consultant Engrs. in air conditioning field; Douglas Aircraft Co. in automatic control. Seek opportunity for design work in air conditioning or mech. engrg.
Open	R. W. Ingham BSME — June	Prefer field test or mech. research. Past experience includes 3 yr of production tool design & drafting. (Draft status — 4A Reserve).
West Coast	W. D. McBride BSME — July	Desire connection leading to position as quality control engr. or testing engr.

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Free service to employers and members

1960 Engineering Graduates . . .

. . . who want to work in the industries served by SAE—continued.

Preferred Location	Name, Degree, and Date Available	School and Field of Interest
		CARNEGIE INSTITUTE OF TECHNOLOGY
Open	A. J. Albright BSME — June	Desire ME experience along automotive lines, leading to eventual management responsibility.
Open	Delmer Hoover BSME —June	Desire training program leading to project engrg. and eventual managerial responsibility.
		CHRYSLER INSTITUTE
Ohio or Midwest	Robert M. Wolf Master (Auto. Engrg.) — July	Interested in eventual work in sales or advertising.
		UNIVERSITY OF CINCINNATI
Cincinnati	W. T. Powell, Jr. ME — June	Seek opportunity to do research work. Have had experience in doing a research project.
Southwest	R. S. Pringle, III BSME — Aug.	Desirous of position in plant engrg. Have 2 yr experience in said field through co-op program.
Open	Fred Ziegler ME — June	Prefer opportunity in medium sized company doing design work with opportunities for advancement.
		CITY COLLEGE OF NEW YORK
Open	Arthur Myers BME — Feb.	Seeking position as jr. engr. with small or medium-size firm that offers opportunity for advancement to responsible design and development work in high speed rotating machinery (turbine, pumps, blowers, etc.). Firm should be willing to subsidize in whole or part expense of Masters Degree.
		CLARKSON COLLEGE OF TECHNOLOGY
N.E. & N. Central U. S.	R. C. Valentine BME — immediately	Seek position with concern manufacturing automobiles and/or automotive accessories in mfg. or production depts. 3 summers as auto mechanic has provided much needed practical experience.
		UNIVERSITY OF COLORADO
Western U. S.	S. J. Navickas BSAE — June	Desire connection leading to position of aerodynamics engr. 1 yr experience in missile and aircraft flight test data analysis. High scholastic standing in graduating class.
		UNIVERSITY OF DETROIT
Detroit	R. P. Suriano BSME — June	Worked with Detroit Edison Co. and Univ. of Detroit Mech. Engrg. Lab. Interested in research work in automotive field.
So. Ontario, Can.	D. S. Moyes BME — June	Interested in sales engineering in heating, ventilating, refrigeration, and/or air conditioning field. Worked co-op job in field of temperature control (15 mo.).
U. S.	C. J. Baumann BME — June	Age 27, married. USAF veteran. Experience varied engineering in automotive (6 mo.) missile (6 mo.) tractor (6 mo.). Prefer opportunity in design, cost analysis, or sales.
Lower Mich.	L. A. Kennedy BME — June	Seek position in the field of stress analysis.
Detroit	L. R. Calvisi BA — June	Seek job which might be first step in equipping me for responsibile work as a design engineer. Have some experience through program.
Open	J. L. Kneese BSME — June	Want technical sales engineering; experience 5 yr training for industrial heat treat furnaces & air conditioning firm, 3 yr co-op on-the-job training. Married — age 24.
Mich.	J. E. Blaska BME — June	Age 26. Veteran & married. Experience 1 yr. drafting at C. W. Smith Engrg. Co.; 1 yr. machinist at Congress Tool & Die Co.; 1½ yrs. engrg. research at Holley Carburetor. "Desired" product, mfg., plant, or sales engr.
Detroit or Southwest	W. F. Barr BME — June	Age 22. Married. Draft status-exempt. Job wanted: design or R & D. Experience design (missile components & GSE). Familiar with government procedures, auto. engrg. & evaluation testing.
Detroit	C. A. Pace BME — June	Interested in work with either a mechanical or electro-mechanical design group. (With possibility for work, later on, in adm. engrg.). Have had valuable experience in industry in conjunction with a co-op engrg. program.
Detroit	D. E. Haase BME — June	Married, age 27, honorably discharged from USA. Research and development field preferred. 3 yr experience at U. of Detroit Lab.
Open	S. E. Chocholek BSME — June	Diesel exper.; 5 yr USN and 2½ merchant marine engr. officer; 1 yr. trans. exper. testing; 1 yr (part time) tool & die. Desire ME position leading to mgmt. Married — 3 children.
Open	Gary P. Farrell BME — May	Cooperative education has afforded experience in areas of production engrg., quality control, & missile GSE design. Prefer work eventually leading to a position in administrative engrg.
Detroit	R. A. Baldwin BME — Sept.	Co-op engrg. experience. Plan graduate work in business administration. (Co-op Plan) ROTC graduate.
Detroit	P. R. Chervenak ME — June	Desire career as design engr. 3 yr experience in product detailing & layout. Military obligations are completed.
Detroit	R. C. Dodt ME — June	Interested in structural design. Would like to get into this type of occupation.
New York or Detroit	F. A. Fazzio BME — June	Most interested in eventual work in sales engrg. Intend to go to night school for a masters in business after graduation. Have been employed by Ford Motor Co. for 3 yr as a co-op engr. in their quality control section.
Detroit area	G. J. Hensien BME — June	Desire opportunity leading to position of liaison engr. Training experiences include piston and gas turbine engines.
Open	T. J. Murray BME — Sept.	Desire position with mfg firm as automotive, aircraft, missile, etc. Have had co-op training in automotive and missile industries.

Free service to

Preferred Location	Name, Degree, and Date Available	School and Field of Interest
East	T. E. Brady BME — June	Most interested in eventual work as patent attorney.
Europe or S. America	L. J. Ybarrondo BME — June	Engineer, first quartile class standing, desires administrative engrg. position. 2 yr experience in missile field, 1 yr in tractor and implement field.
		ECOLE POLYTECHNIQUE
Montreal	Raymond Felx BS — May	Interested in any mechanical field. Prefer heating & ventilating sections.
Open	Jean Brunelle BS — May	Seek job in mech. dept. of a mfg. company which might lead to a responsible position. Last summer job made me decide on that line.
Montreal area or E. Canada	F. A. Belanger BASc — May	Most interested in eventual work in administration, starting from sales & services or industrial engrg. dept.
Province of Quebec	R. M. Martin BASc; BA in ME — May	Seek interesting job in mechanical engineering. Particularly in heating & air conditioning.
Open	Roy Jacques P. Ing. (Mechanical) — May	Would like to be a sales engineer or if it is possible to work in administrative engineering.
		FENN COLLEGE
Cleveland Area	A. J. Riccio ME Ind. Opt. — July	Most interested in finding position in industrial engrg. field, preferably in production control or estimating. Also interested in machine design. Working with others preferred to isolated designing.
Cleveland	E. W. Greenwald BME — July	Seek position in design or development field which would lead to eventual supervisory or administrative engrg.
		GENERAL MOTORS INSTITUTE
Open	James Coulter BME — August	Interested in design or research work in automotive, missile, or computer fields. Experience in automotive design and radio.
Dayton, Ohio	R. J. Parker BME — Aug.	Prefer job that involves both design and test engrg. Am currently working on high-temperature hydraulic seal research.
Open	R. L. Smith BME — Aug.	Desire position in coordination or instruction of industrial education, management, or technical training programs.
		UNIVERSITY OF ILLINOIS
Midwest	J. W. Wiswall BSME — Feb.	Desire work in engine research and development.
Small city in Midwest	D. B. McVickar BSME — Sept. '59	Prefer work dealing with thermodynamics in the automotive industry.
		INDIANA TECHNICAL COLLEGE
South or West	E. J. Groome BS — Sept.	Age 26, married — 1 child. Worked 2 yr as machinist apprentice at Brown & Sharpe Mfg. Co. Served 3 yr in Air Force as pilot.
East or Midwest	J. M. Lewis BSME — March	Seek position offering training and opportunity for advancement in automotive product test & development engrg. Past experience as an automobile mechanic.
Midwest	E. C. Meissner BSME — Dec.	I desire a position with a diesel engine mfg. firm and am most interested in research and design relative to the application of diesel power in diesel-electric power plants. Have 6 yr experience in diesel field.
Anywhere in U.S.	J. O. Tennies BSME — Mar.	Seek job that will lead to work as a design engr. Some experience in designing.
		LAWRENCE INSTITUTE OF TECHNOLOGY
Michigan	W. C. Kremer BS Bus. Adm. — June	5 yr experience in production control, material handling engrg., and assembly process engr. Desire management position in relative fields.
Midwest or East	W. J. Flower BSME — June	Desire position leading to employment as a design engr. on work involving thermodynamic analysis.
Mid.-U.S.	L. J. Cope BS — June	Desire connection leading to position in personnel or purchasing.
Detroit	D. C. Morrison BSME — July	Desire position in the field of plant engrg. Summer jobs have provided some experience in plant layout work.
Detroit	C. R. Allmen ME — June	Prefer position in automotive field doing design, test, or experimental work on new products.
Michigan	R. E. Roland BSME — August	Desire position which might be the first step in equipping me for work in original research as on the development of new ideas and products.
Detroit area	R. C. Getoor BSME — June	Most interested in technical admin. eng., such as project supervision. Am a night school student with 4 yr experience as a project engr. Have done research with all types of highly instrumental engines. Projects under my direction have led to two major break-throughs in the field of smog and air pollution control.
		MANHATTAN COLLEGE
N.Y.C. or L.I.	Robert Normandin BME — June	I would prefer work in production and control engrg.
N.Y. area	J. A. Pollono BME — June	Interested in automatic controls and mathematical research.
East	Paul Vermaelen BME — July	Interested in automatic controls. Plan to do graduate work.
Greater N.Y. area	M. S. Solebello BME — July	Seek job which might be first step in equipping me for responsible work as mech. engr. specializing in automatic control.
		MARQUETTE
Open	C. H. Torner BSME — Jan.	Interested in eventual work in adm. engrg. Plan to combine M.S. in Business Adm. with engrg. degree.
		UNIVERSITY OF MIAMI
Florida	Dick Clarke BSME — July	Enjoy doing original research. Interested in eventual position in administrative engrg. Part time job has provided some practical experience (airline).
Cuba	Rinerio Cairo ME — Sept.	Prefer opportunity in sugar mill plants as manufacturing supervisor.
Florida	J. E. Colbert BSME — July	Desire work in aircraft or automotive power plant design or testing.
		MICHIGAN COLLEGE OF MINING & TECH.
Open	K. E. Richter ME — Sept.	Desire work with company manufacturing outboard motors. Have had 4 summers experience as an outboard mechanic. Am taking the automotive option of Mech. Engrg.
Detroit area	Jack L. Thom BS — July	Desire position with a combustion ignition engine manufacturer or research and development company.
		MICHIGAN STATE UNIVERSITY
Anywhere	G. W. Martin BSME — June	Would be interested in any company which could give me experience in the field of instrumentation engineering.

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1960 Engineering Graduates . . .

. . . who want to work in the industries served by SAE—continued.

Preferred Location	Name, Degree, and Date Available	School and Field of Interest
		MILWAUKEE SCHOOL OF ENGINEERING
Anywhere USA	D. J. Schrage BSME — Jan.	Desire connection leading to position in automotive type refrigeration & air conditioning research & development.
South or Southwest	R. A. Pettingill BSME Met. Fab. Major — June	Most interested in a position leading to a responsible job as a welding engr., production or design.
West — Midwest	J. H. Walkowiak ME — October	Seek job in administrative engineering; prefer company with training program.
		MISSOURI SCHOOL OF MINES AND METALLURGY
Midwest Southwest	Gilbert Cirrincione BSME — Aug.	Interested in machine design & development.
Missouri Illinois	R. L. Kimmich BSME — June	Seek job which might be first step in equipping me for responsible work as manufacturing supervisor.
Open	A. Pawlowski, Jr. BSME — June	Seeking an opportunity as field engr. (working with people, things, and numbers) in the power industry.
Open	D. E. Schneider BSME — Jan.	Most interested in tech. or engrg. sales leading to eventual management position. Working with others preferred to isolated designing.
West & Midwest	G. A. Bagby BSME — Jan.	Seek job which might be first step in equipping me for responsible work as quality control engr.
Midwest	R. G. Hanquist BSME — June	Seek job which might be first step in equipping me for responsible work as maintenance engr. supervisor.
Los Angeles	E. E. Mertl BSME — Feb.	Seek job which might be first step in equipping me for responsible work in engrg. management.
Any	G. L. Scofield BSME, BA (Lib. Arts) — June	Seek challenging opportunity in mech. design. Have experience on assembly line; in drafting, technical illustrating, and liaison engrg.
Open	J. H. Loos BSME — Feb.	Seek position as test & development engr. Have 1 yr mech. engr. experience and 5 yr varied industrial experience.
U.S.A.	H. W. Kosten BSME — June	Would like to start in sales with a possibility of advancing into administrative work. Have had experience during summers in foundry and machine shop work and would like to stay with that kind of product sales.
Midwest	R. G. Nelson ME — June	Prefer opportunity in dept. doing vehicle power plant design. Either surface or air type.
		UNIVERSITY OF MONTREAL
Open	P. J. R. E. Godbout BScA (Engrg. Physics) — May	Desire connection leading to position in nuclear engrg., missile, and orbital space vehicle or administrative engrg.
		NEW YORK UNIVERSITY
New York area	Kevin Sheehan BME — June	Desire position leading to automotive design of passenger cars. Have had 4 summers experience as an engineer's assistant in 3 different companies.
West	J. B. Remensnyder BME — June	Desire work leading to responsible position as a research or test engr. in the line of fluid machinery.
Anywhere	Gilbert Zweig BME, AB — June	Seek job in which an opportunity for going to graduate might be provided.
		NORTHROP INSTITUTE OF TECHNOLOGY
Calif.	H. A. Smith BS — April	Aero. engr. desires employment with company in rocket or missile field. Some practical experience as jr. design engr. with aircraft mfr.
New York area	R. A. Sigerist Aero. Engr. Technology — Dec. '59	Seek position in systems design — or in aerodynamics in department where advancement is possible.
Marietta, Ga. (Lockheed)	N. T. Frangias BS — March	Seek position which might be first step in equipping me for responsible work in design engrg.
Calif.	E. L. Phelps BS — Apr.	Especially interested in aircraft maintenance engrg. Preferably work connected with aircraft powerplants.
Calif.	T. F. Warren BSAE — Electronics Major — June	Prefer opportunity in dept. doing original research on missiles. Interested in work as design engr. 5 yr experience flying for USAF.
Open	B. K. Neil BS-AME — Apr.	Field servire, lab and/or field testing, liaison, technical rep. Prefer missile and/or aircraft. 4 yr USN. Mech. maintenance on all types of military aircraft.
East Coast	S. A. Mackin BS — June	Desire position in airplane design engrg.
Calif. Desert	R. A. Sharp BSAE — April	Desire opportunity which would be first step toward responsible work as design engr.
N. Calif. Pacific Coast	C. L. Landers BSAE — Oct.	Prefer position with opportunity in "new designs." Research in this area desirable. Interests are aircraft propulsion systems & aerodynamics.
Outside Los Angeles area	A. H. Greiert, Jr. BS (Aero. Engrg. — July	Prefer aircraft or modification design position. 1800 hr. pilot time, commercial FAA ratings; single, multi-engine DC-3 and instrument. 8 yr experience as manager, custom millwork business.
Northwest	H. T. Lund BS — Oct.	Desire opportunity leading to position in aircraft technical rep. field.
Midwest, East	S. A. Kuzoff BS — June	Would like to work in test lab. facilities; hydraulics engr., or as a field rep.; flight control engr.
Midwest, Michigan	R. C. Davis BS — Jan.	Seek position with company manufacturing aircraft engines which would lead to sales engrg.
Midwest or Southwest	A. D. Van Winkle BS (Aero. Engrg.) — Apr.	Seek work leading to position in design engrg. Part time job as jr. design engr. has provided some experience.
Denver, Colo.	Milton Rountree Aero. Eng. (Electronic Major) — June	Seek representative type position (travel agreeable). Experience: 2 yr, service manager; 15 yr, supervisory (parachutes, oxygen equipment) military.
Anywhere	John D. Ryan BS — December	Interested in eventual work in Administrative Engineering. This type of work better fits my capabilities.

Free service to

Preferred Location	Name, Degree, and Date Available	School and Field of Interest
Midwest	J. D. Schneider Tech. Dipl.-A.E. — Jan.	Desire position that will provide practical experience in design engineering.
Los Angeles area	W. R. Wodell Tech. Dipl.—Jan.	Prefer work leading to a position in research or testing. Especially interested in wind tunnel testing or strength of materials.
Toronto Canada or Vicinity	L. C. Hykel BSAE — Jan.	Seek job which might be first step in equipping me for responsible work as preliminary design engineer.
		NORTHWESTERN UNIVERSITY
Western US but preferably S. Calif.	J. R. Erisman BSME — July	Most interested in research and development type of work in automotive and/or aviation type industry.
		OHIO STATE UNIVERSITY
Open	P. V. Whitney Jr. BSME — June	Interested in research & development or machine design. Presently working as a research assistant.
		OKLAHOMA STATE UNIVERSITY
Rocky Mts. or West Coast	W. H. Cave BS — Aug.	Desire position in sales engrg. dept. with opportunity for advancement. Military service completed.
Open	K. C. Ponsor BSME — June	Desire work which would give me an opportunity to move toward administrative and management functions.
Great Lakes Region	L. K. Drake BSME — Feb.	Seeking job leading to managerial position in automobile design, development, or testing. One summer experience in engine testing lab. Two summers experience operating own business.
		OREGON STATE COLLEGE
California	L. H. Chenault BSME — June	Interested in test, development, and/or design work in mech. or mech./elect. engrg. Have had considerable summer experience in automotive development and testing. Future to have management possibilities.
West Coast	D. L. Blomquist BSME — June	Prefer work with company doing research on fuels & lubricants. Past experience has been with aircraft and automotive IC engines, providing basic knowledge for work in engine laboratory.
		PARKS COLLEGE OF AERO. TECHNOLOGY-ST. LOUIS UNIV.
Western U.S.	D. W. Fitzgerald BS — Aug.	BS in Aircraft Maintenance Engrg. Hold a commercial pilot's license and A&P mechanic's license. Desire connection leading to position as tech. rep. with company in aviation or missile field.
Cleveland	F. W. Kosmerl BS (Aero. Engrg.) — Dec. '59	Experience: tool & die maker apprentice for 15 mo.; drill press & kick press operator for 3 mo.; die cast machine operator 2 yr.
Open	Michael Oelsner BS in Aircraft Maintenance Engrg. — April	Prefer opportunity in the hydraulics dept. in aircraft co., have 1 yr experience in hydraulics work and repair.
East, West, or South	Henry J. Hunter BS in Aero. — Dec. '59	I am best qualified for aircraft maintenance engrg., but would prefer to go into the missile field in flight test or aerodynamics.
		UNIVERSITY OF PITTSBURGH
Pittsburgh area	Donald Suchy BSME — Dec.	Seek job which might be first step in equipping me for responsible work as a manufacturing supervisor.
West Coast	G. S. Nicholas BS — Dec '59	Most interested in stress analysis and design; wouldn't mind trying sales.
Northeast or South	R. M. Holliday BS — April	Desire either some type of machine design or heat transfer. Working with others out doors preferred. Also, would not prefer white collar job in office.
Pittsburgh area	William Bilec BSME — April	Desire position as sales engr. Ultimate interests lie in administrative field.
Pittsburgh	N. J. Scheid BS — Apr.	Prefer position as maintenance engr. Working with others preferred to isolated position.
Pittsburgh or California	P. A. Murray BS — April	Experience in factory work. Familiar with union setup & production work.
U.S.	F. J. Grejda ME — April '59	Most interested in eventual work in administrative engrg.
Open	J. W. Galambas BSME — April	Desire a position in automotive design field. Have had some experience with the automobile engine and machine shop practices.
Willing to travel	R. N. Bubash BS — April	Desire position associated with heat transfer in design problems. Prefer working with group rather than working alone.
Open	T. A. Eberhart BSME — April	Desire a job which will lead to a position in administrative or operational engrg.
West Coast	P. R. Greenaway BS — April	Korean veteran, married, with family, seeks chance to begin a career in engineering and related fields.
Open	M. T. O'Connor BSME — June	Prefer thermodynamics — possibly sales engrg. in this field. Currently employed part-time in consultant engineer's office.
Pittsburgh	W. C. Donovan BS — Jan.	Most interested in sales or administrative engrg. Would prefer working for a company with training program in either of these fields.
Pittsburgh	D. M. Capone BSME — April	Desire position doing development work, working on the steps from the idea to design.
Pittsburgh vicinity	L. H. McClory Jr. BSME — April	Prefer job which will eventually lead to research or development position.
West	Guy Fauconneau BS — May	Seek job in mech. engrg. with company having branches in foreign countries. I speak French & Spanish fluently.
Pittsburgh area	G. F. Benjock BSME — April	Seek job which might be first step in equipping me for responsible work as design engineer. Would appreciate any opportunity for employment giving practical experience in this field.
		PURDUE UNIVERSITY
Open	Robert Pursley BSME — Aug.	Seek position in testing & development of automobiles or aircraft — especially with regard to engines.
Chicago area or Midwest	J. A. Mattila BSME — Aug.	Mainly interested in internal combustion engine and gas turbine applications to passenger cars, trains, buses, and boats — in area of design and/or performance testing.
Open	A. C. Doty BSME — Feb.	Interested in work pertaining to product engrg. or testing. I have 2 summers work experience.
San Francisco Dayton Lafayette	L. M. Brubaker BSME — June	Prefer job which leads to position of design engineer, process engineer or technical writer. Have 2 full years engineering experience.

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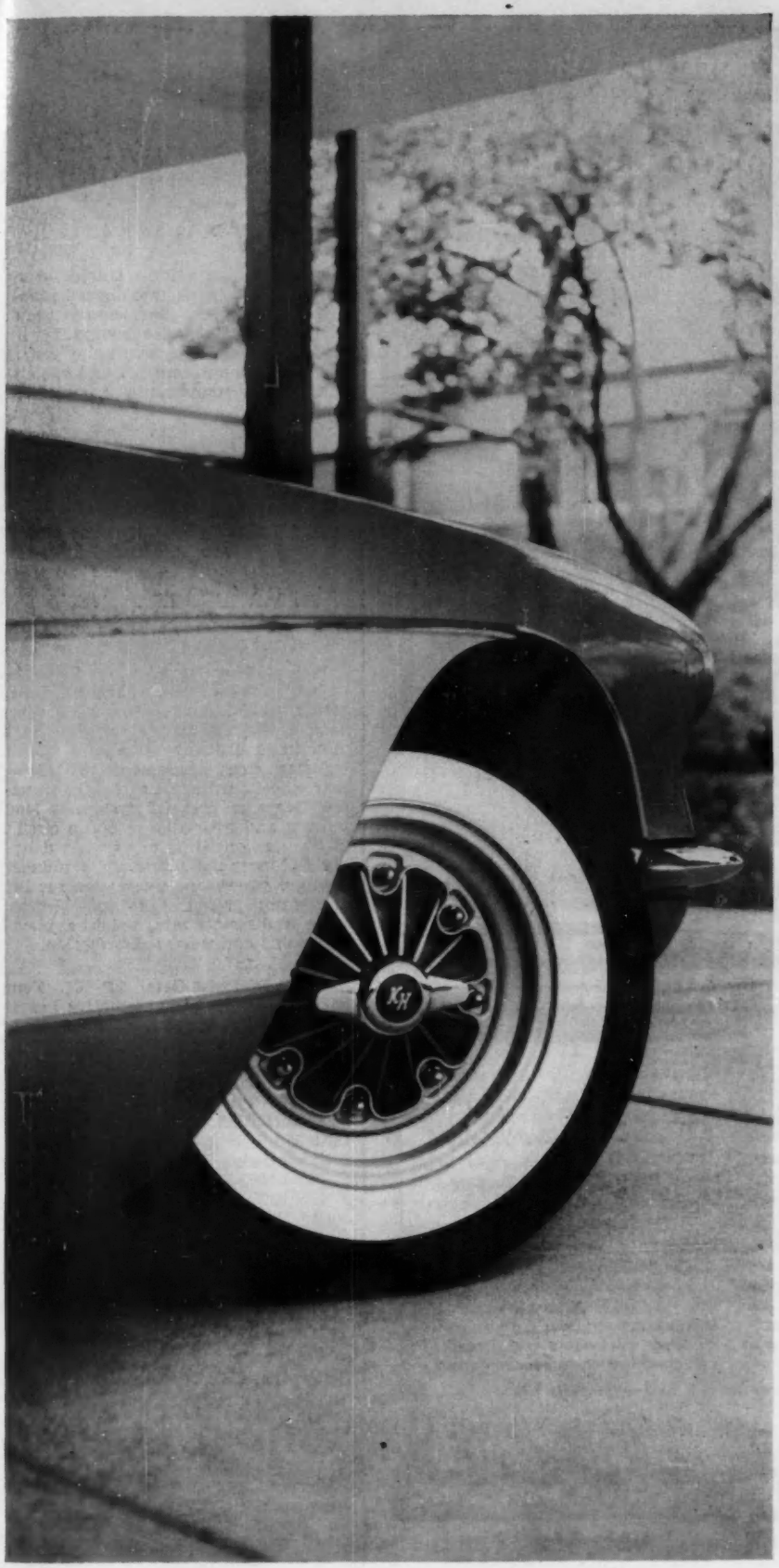
1960 Engineering Graduates . . .

. . . who want to work in the industries served by SAE—continued.

Preferred Location	Name, Degree, and Date Available	School and Field of Interest
Midwest	R. G. Lenz BS — June	Interested in sales or production phases of engrg.
		QUEEN'S UNIVERSITY
Canada	H. R. E. Hoare BS, App. Sci. — June	Seek job in plant maintenance which might equip me for position as maintenance engr.
		SAN DIEGO STATE COLLEGE
So. Calif.	L. K. Smith BSE — July	Desire employment which might serve as a first step toward a mechanical (design) engineering position.
Mild climate	R. L. Gerber BSME — Feb.	Prefer opportunity in test and development of agricultural or heavy construction equip. either in U.S. or abroad.
San Diego	C. W. Nelson BS — June	I am a mech. engr. student with interest in the applications of heat transfer in the heating & ventilating industry.
Open	K. K. Conger BSME — June	Desire job with licensed engineer as training for becoming same. Experience: 2 yr half-time in engineering test lab. and 2 summers in elec. powerplant maintenance.
		UNIVERSITY OF SASKATCHEWAN
U. S. or Canada	J. K. Walker BE — May	Control systems; have done research at university on interference filters (light)-high vacuum; experience with electronics.
		STEVENS INSTITUTE OF TECHNOLOGY
Metropolitan New York	M. Bojcik, Jr. ME — June	Interested in production or development eventually leading to sales or management engrg. Prefer large company to small.
Open	Selwyn Gross BS Eng. — June	Desire position in applied research or development (especially interested in missiles); 6 yr work of creative and detailed nature in woodworking industry; veteran, 29, single.
		TEXAS A & M
Southwest	W. B. Baker BSME — June	Desire job involving design & testing of mech. components. 2 summer jobs have provided some practical experience. Have completed military service.
Texas	B. D. Sevier ME — Jan.	Desire work leading to design engr. or production engr., possibly leading to supervisory position.
Southwest	J. L.Hill BSIE — June	Most interested in a job which might lead to responsible work in production engrg. Have completed military obligation.
Southwest	E. C. Sarlls, Jr. ME — June	Prefer a position dealing with original design.
		UNIVERSITY OF TEXAS
Open	G. W. Caldwell BSME — Feb.	Desire location in automotive industry leading to position of automobile stylist. Have artistic talent and deep interest in styling.
		UNIVERSITY OF TORONTO
Open	R. F. G. Baker BASc — May	Have experience in design, production, & quality control with large auto. mfg. co. Desire position connected with production or quality control with auto. mfg. or allied accessory mfg. co.
		TRI-STATE COLLEGE
Illinois, Michigan, or Indiana	J. H. Evans BS — March	Am in the upper fourth of my class with my interests in design, production, heat transfer, math, and sales. I have had some experience in leadership and trinket making.
Pennsylvania or E. Ohio	G. W. Carter BSME — Apr.	Prefer work leading to development and design of mechanical components. One year experience in machine design.
		WASHINGTON STATE
Northwest	G. D. Haynes BS Agr. Engrg. — March	Prefer work with agricultural processing equipment, refrigeration, or electrical equip.
		UNIVERSITY OF WASHINGTON
West Coast	R. V. Hokanson BSME—April	Desire position in direction of admin. engrg. in transportation or heavy equipment field. 15 yr experience as owner-operator of heavy-duty motor transport & construction equipment. Good management potential.
California	L. E. Johnson Jr. BSME—April	Am particularly interested in work which will provide me a career involving admin. engrg. or management. Two summer jobs have provided a background for this interest or goal. The jobs were with Shell Oil.
West	J. M. Workman BS—June	Prefer work with eventual administrative opportunities. Two years college bus. admin. Several years working experience (before entering engrg.).
		WAYNE STATE
Open	V. E. Brooks BSME—June	Desire opportunity in aircraft or automotive industry. 2 yr experience in hydraulics.
Detroit area or Florida, Gulf-side	P. G. Arndt BSME—Feb.	Desire opportunity for design work in the field of hydraulics that would eventually lead to the responsibility of all hydraulic applications on products manufactured by the company. 2½ yr design at Vickers.
Open	G. O. Hansen Jr. BSME—Feb.	Seek job which will lead to internal combustion engine design and/or development.
		UNIVERSITY OF WISCONSIN
Open	D. Saltzman BS—June	Would like work in design or development, preferably in aircraft or missile field.
		YALE UNIVERSITY
East	H. S. Kieser BE—June	Most interested in eventual work in an admin. position. Would go to business school later on if it would be advantageous.

Free service to employers and members



wheels that speak with international good taste

Working closely with the automotive industry for over fifty years, Kelsey-Hayes has pioneered many major advances in wheel and brake design. Among the most recent is the new integral cast-aluminum hub and drum, wherein the braking surface is provided by a special iron liner metallurgically bonded in place. Exposed to the air-stream, through a specially designed steel wheel, its ribbed aluminum structure affords maximum cooling for uniform, fade-free brake performance and greatly extended life. Kelsey-Hayes Company, Detroit 32, Michigan.

KELSEY HAYES COMPANY

Automotive, Aviation and Agricultural Parts
Hand Tools for Industry and Home

18 PLANTS: Detroit and Jackson, Michigan; Los Angeles; Philadelphia and McKeesport, Pennsylvania; Springfield, Ohio; New Hartford and Utica, New York; Davenport, Iowa; Windsor, Ontario, Canada.

Briefs of SAE PAPERS

continued from p. 6

Co.; elements of unit are tractor, semi-integral implement (moldboard plow), and hitch; typical performance graph of Case 811-B tractor equipped with Case-O-Matic Drive hydraulic system consists of pump, controls, and two circuits; major components of implement and hitch.

Draft Control Hitch With Hydraulic Transport Wheel, R. W. WILSON. Paper No. 96U. Concept developed and specifications set up in building semi-mounted plow for Ford tractor; plow is attached to conventional three point draft controlled linkage of Ford tractor; construction details; diagrams showing plow hitch in plowing and transport position; force diagrams.

Weight Transfer with Limit — Control of Semi-Integral Implements, R. W. JOHANSEN. Paper No. 96V. Two basic types of semi-integral implement mountings utilizing automatic weight transfer from implement to tractor rear wheels; principle of weight transfer; heart of transfer system is load sensing and hydraulic response circuit of tractor consisting of variable delivery 3-plunger pump and single plunger pressure generating pump; tractor lift arm ram; pressure limiting diverter valve, and remote ram; weight application point and weight distribution.

Safety Motorist Gets. SP-165. Four papers representing automotive industry (Chevrolet Motor Div., Fisher Body Div., Buick Motor Div. of General Motors, Chrysler Corp., Ford Motors, American Motors, Ford Proving Ground and GM Proving Ground): Chassis, N. H. McCUEN, J. F. ADAMSON, O. D. DILLMAN, F. G. OLSEN, 1–9; Automobile Body, R. H. FREDERICKS, C. W. CENZER, W. J. CLARK, P. O. JOHNSON, 11–16; Electrical Accessories, R. F. JENSON, T. R. KILGOUR, C. W. RAINEY, P. FAIR, 17–24; Over-All Car Appraisal, W. R. RODGER, T. M. LAWLER, H. L. PRESCOTT, K. A. STONEX, 25–37.

MISCELLANEOUS

Compaction Theories and Their

continued on p. 112

Presented here are brief digests of recently presented SAE papers. These papers are available in full in multilith form for one year after presentation. To order, circle the numbers in the "Readers Information Service" blank on page 6 corresponding to the numbers appearing after the titles of the digests of interest to you.

Briefs of SAE PAPERS

continued from p. 110

Practical Application, B. K. HOUGH. Paper No. 89T. Theories relating to soil behavior during compaction process of interest to engineers designing earthmoving and compaction equipment; definitions of terms consolidation and compaction; equipment and special processes used; variables to consider with respect to compaction specifications; improvement of building sites representing new field of application for compaction equipment.

Compaction of Highway Embankments and Surfaces, H. A. RADZIKOWSKI, J. J. LAING. Paper No. 89U. Basic concepts, method of construction control and current density requirements for highway elements; methods for density determination; limitations of AASHO Methods T-99 or T-180; nuclear testing devices for density moisture determinations; special equipment requirements in various States; design developments such as self propelled features for pneumatic rollers, h-p smooth tread compactor tire for compacting flexible courses and pavements, etc.

On the Job Training, N. BROOKS. Paper No. 84V. Scope of General Motors Training Centers for instruction of service instructors to train apprentices or new employee and keep up-to-date with changes in servicing procedures; outline of training program and techniques used; recommendations made.

Experience with Turbochargers in Marine Use in British Columbia, R. H. GARRETT. Paper No. 87V. Results of survey to obtain data on experience of marine engine owners with turbochargers are summarized; it appears that in marine duty turbocharger and engine can be matched without compromise for maximum efficiency; survey covered 143 engines of 11 different makes.

Also available . . .

1959 SAE TRACTOR PRODUCTION FORUM . . . SP-328 consists of reports on 9 panels, as follows:

Heat-Treating Techniques, reported by R. A. HUSEBY, secretary. Discusses very briefly (1) proper material handling of machined parts prior to and during heat-treatment; (2) high temperature carburizing; and (3) developments in induction heat-treatment.

Welding Methods and Process Control, reported by IVAN KUTUCHIEF, secretary. Outlines briefly general current trends in welding processes; mentions that advent of the CO_2 gas-shielded metal-arc process brought a significant change in the welding industry. This process, originally applied to thin gage metals, now can be used on heavy plates and multipass welds.

Planning — Organizing — Controlling the Administrative Function, reported by FRANK PAPPAS, secretary. Defines objectives of planning and control; lists techniques which must be applied to make them effective; and mentions the principles upon which they should be developed. As to controls, "the most important considera-

continued on p. 114

YOU GET MORE KNOW-HOW WHEN YOUR "SPECS" READ HYATT

because HYATT has built *millions* more cylindrical roller bearings than anyone else for two thirds of a century. And every year for the last 67 years we have learned to make them run longer, smoother, more reliably. Remember, *no bearings carry radial loads like cylindrical bearings—and nobody knows them like HYATT.* Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ***HY-ROLL BEARINGS***

IN ROLLER BEARINGS HYATT IS THE WORD FOR GM RELIABILITY

Briefs of SAE PAPERS

continued from p. 112

tion is what degree of control is needed."

How to Prepare Engineers for Management, reported by K. W. HINSCH, secretary. Emphasizes that "all development is self-development" . . . and that each supervisor is accountable for the achievements of his deputies. Gives strengths and weaknesses of the average engineer as a manager and develops the idea that "real managers consider customers the most important people they know — and will do anything to take good care of them."

Production Planning and Control for Profit, Cost, and Service Improvement, reported by ROBERT McINTURFF, secretary. Lists in brief form the main points to be covered in forecasting future sales and requirements; stock status projections; shop loading techniques, central dispatching and expediting control, and selective analysis techniques.

Engineering — Purchasing Relationships, reported by E. E. BRYANT, secretary. Shows the important part played by the engineer in purchasing and details how his influence can be most effectively exerted.

Cost-Saving Ideas — or Cost-Reduction for Survival, reported by J. F. GINTHER, secretary. A compact manual of cost-saving methods and ideas for automotive manufacturing plants. Includes a complete checklist of areas to investigate for cost reduction.

Applying Automation Under Today's Operating Conditions, reported by ROBERT SEMMLER, secretary. Contains expert advice on planning for future automation lines; a few brief case studies from the experience of a company which pioneered in automation; a discussion of numerically controlled equipment; and differentiation between the two basic types of fully automated machine tool systems — the fixed program type and the selectable program type.

A Complete Quality Control Program, reported by RAY MORRIS, secretary. Coverage of this general subject is detailed in specific discussions of engineering applications of quality control; quality control and job-shop operation; how management looks at quality control; and selling quality control to the organization.

To Order SP-328 . . . on which this article is based, see p. 6.


BENDIX
EXHIBIT
S. A. E. MEETING
SHERATON-CADILLAC HOTEL
JANUARY 11-15, 1960
BOOTH NUMBERS 37-40
Bendix Filter Division
Detroit, Michigan
Bendix Products Division
South Bend, Indiana
Bendix Radio Division
Baltimore, Maryland
Eclipse Machine Division
Elmira, New York
Lakeshore Division
St. Joseph, Michigan
Marshall-Eclipse Division
Troy, New York
The Sheffield Corporation
Dayton, Ohio
Bendix
AVIATION CORPORATION

SAE Members

continued

JOHN G. BRUCE, previously equipment manager, is now assistant project manager, at Mannix Co., Ltd. in Alberta, Canada. Bruce was vice-chairman of SAE Alberta Group in 1956–1957.

R. LEE SISLER has joined Minnesota Mining & Mfg. Co. as project engineer. For the past three years he served Caterpillar Tractor Co. as research engineer.

RAY DUBOC, president of R. E. Duboc Associates, has been named to service National Electric Welding Machines Co.'s new sales office, covering the five-state territory of New Mexico, Utah, Wyoming, Idaho and Colorado.

WINFORD BRUNSON HICKMAN has become product engineer for the Brown Trailer Division of Clark Equipment Co. Formerly he was chief research and development engineer at Dorsey Trailers.

HANS J. ANDERSEN, previously manager of engineering services at Minneapolis-Moline Co., has become senior product engineer for J. I. Case Co.

Obituaries

LOUIS E. BLUM . . . (M'21) . . . retired chief draftsman at Breeze Corp. . . . taught a course in tool design two evenings a week at Newark College of Engineering . . . died September 25 . . . born 1893.

R. K. BRAUNSDORFF . . . (M'38) . . . technical adviser to general manager in automotive production for Tung-Sol Electric Co. . . . died November 16 . . . born 1896 . . . helped to develop automotive directional signal lights and seal-beam headlights . . . was member of SAE Lighting Committee and Chairman of its Bulb Subcommittee.

WARREN H. FARR . . . (M'20) . . . retired president of Ainsworth Mfg. Co., chairman of the board . . . died October 6 . . . born 1889.

BENJAMIN GOLDFARB . . . (M'53) . . . secretary-treasurer of Ancorp-Salawitch, Inc. . . . died October 12 . . . born 1908.

FREDERICK G. HUGHES . . . (M'10) . . . chairman of the board, North Side Bank & Trust Co. in Bristol, Conn. . . . died October 3 . . . born 1878 . . . was to receive certificate for 50 years membership in SAE.

ALFRED JAMES POOLE . . . (M'10) . . . retired sales and service manager, Diesel Engine Products, Scintilla Division, Bendix Aviation Corp. . . . died November 2 . . . born 1881 . . . was SAE vice-president representing diesel engine engineering in 1932.

CHARLES G. PURNELL . . . (M'55) . . . manager of market development at Jessop Steel Co. . . . died October 1 . . . born 1893.

SUMNER B. SARGENT . . . (M'55) . . . president of Sargent Engineering Corp. . . . died October 18 . . . born 1901.

ROBERT B. SCHENCK . . . (M'22) . . . retired . . . died August 22 . . . born 1886.

WOLDEMAR G. SCHULTZ . . . (M'31) . . . automotive engineer at Ford Motor Co. . . . died October 13 . . . born 1895.

BENJAMIN F. TOBIN, JR. . . . (M'19) . . . president and general manager of Continental Sales & Service Co. . . . died August 29 . . . born 1890.

EARL S. TWINING . . . (M'26) . . . retired head of Racing Division of Champion Spark Plug Co. . . . died October 9 . . . born 1892.

JAMES D. VASEAU . . . (M'57) . . . truck product engineer at Ford Division of Ford Motor Co. . . . died October 7 . . . born 1913.

You can keep rust out with workable Armco ZINCGRIP Steel

Rust can't find a place to start on Armco ZINCGRIP® Steel. Moisture is sealed out by a corrosion-resisting hot-dip coating of zinc that hugs the surface of the base metal. The tightly adherent zinc coating flows with the steel base during fabrication. It *stretches* —neither flakes nor peels during drawing, forming, bending, punching, piercing, or other severe working.

In auto parts

Armco ZINCGRIP has proved its advantages in corrosion-prone auto parts. Many kinds of products have been fabricated from this special steel for more than twenty years. Essentially, it offers advantages for many parts where excessive corrosion of uncoated steels may cause poor appearance, malfunction, or loss of necessary strength. Body panels and interior body parts are typical examples.

For additional information about Armco ZINCGRIP Steel, just fill in and mail the coupon.

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ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation

continued from p. 78

much greater than with the longer drains.

• Increasing the level of detergency was beneficial in reducing both varnish and sludge, the benefits being greatest with short drains. With 6000-mile drains the advantages of increased detergency in preventing sludge were largely lost, although they were still appreciably effective in reducing varnish, wear, and rust.

Oil drains of 1500, 3000, and 6000 miles were employed in cars using by-pass filters, with element changes of 3000 and 6000 miles. For reference, cars with no filters were also included. The three oils tested were all of the SAE 10W–30 viscosity grade prepared from the same viscosity improver and base stock. All oils contained the same quantity of a zinc dithiophosphate inhibitor. Two of the oils contained different quantities of the same high-quality alkaline detergent; the third oil contained no detergent.

The service encountered was known to produce heavy sludge and varnish deposits due to the relatively large percentage of operation at idle and light load. Because of this, it is believed that the observed trends of engine deposits and wear are representative of the trends in the majority of passenger cars, although the numerical values may differ.

The data taken as a whole confirm the benefits of MIL-L-2104 and Supplement 1 levels of detergency and good filter maintenance. They also strongly indicate that the average motorist is not realizing maximum motor oil and filter performance when excessively long drain periods are used.

Nylon Tire Excels In Rugged Services

Based on paper by

C. R. McMillen

Goodyear Tire & Rubber Co. of Canada

TREAD rubber is ground off very fast by high-powered, high-speed tandem tractors of the four-wheel-drive type, and the two-wheel-drive pusher type, pulling tandem trailers. And there is a heat problem with continuous high-speed operation, which creates a condition in which nylon and steel cord tires become indispensible.

Indicative of the superiority of nylon over rayon tires is the performance record on buses shown in Table 1. The tough service was in the northern part of Quebec, Manitoba, and Alberta. The greater mileage with nylon tires is due primarily to the reduction in the number of tires removed for carcass conditions.

Table 1 — Comparison of Performance of Nylon and Rayon Tires on Buses

	Nylon	Rayon
Tough Service		
Numbers of Tires	60	107
Per cent Removal for Carcass Condition	3.5	30
Average Mileage (Original Tread)	60,100	40,500
Improved Road Service		
Number of Tires	68	143
Per cent Removal for Carcass Condition	1.5	30
Average Mileage (Original Tread)	74,500	61,400

The mileage gap between nylon and rayon is considerably diminished in improved road service. However when speeds are maintained, the cooler running nylon tire retains its strength and is less subject to heat blowouts. This is true in truck as well as bus operation.

Nylon has one characteristic that re-

continued on p. 126

Pure Automobile

the all-new ones from Chrysler Corporation for 1960

Surrounds you with silent strength

Unibody construction gives twice the torsional strength and 40% more beam strength

Here is a family of cars built a whole new way—the 1960 cars from Chrysler Corporation. We call this new construction Unibody because body and frame have been designed into a single, solid unit.

Gone is the old concept of a body and a frame held together with nuts and bolts. In the 1960 cars from Chrysler Corporation the new, all-welded body gives you a car with twice the torsional strength and 40% more beam strength than cars made the old way.

And also gone, with the nuts and bolts, are a surprising number of squeaks and rattles. These cars ride so quietly they sound and feel like they're going 10 miles per hour slower than they are.

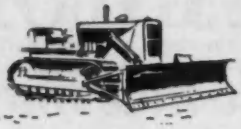
Pure automobile—built stronger to last longer. And styled in quiet good taste to look good longer, too. Simple facts that mean these cars will bring many dollars more whenever they're sold or traded.

Stop in soon at your neighborhood dealer's and get acquainted with the all-new ones for 1960. Let a drive bring out the difference great engineering makes.

The Quick, the Strong, and the Quiet

VALIANT • PLYMOUTH • DODGE DART • DODGE • DE SOTO

CHRYSLER • IMPERIAL



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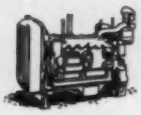
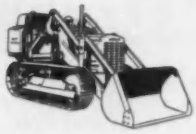
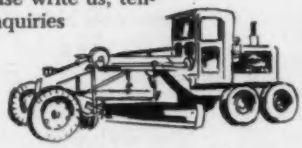
be a part of the company building the world's most complete line of earthmoving equipment

Find the satisfaction of *growth* and *stability* within a *growth* company — where imaginative men are creating products for highway construction — industry — farms — national defense — products which build a better world.



Caterpillar offers top ranking Research and Development opportunities — stimulating assignments — professional and personal advancement. You'll associate with the leaders and pioneers in this field — and have at your command the finest equipment, laboratories and development facilities. Please write us, telling all about yourself. Inquiries are confidential, of course.





(Below — New Caterpillar Technical Center presently under construction)

responsible positions available in
RESEARCH — DESIGN DEVELOPMENT

GAS TURBINE LABORATORY
Aero-thermodynamics • instrumentation • design • experimental development • stress and dynamics • combustion • controls.

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Fuel injection systems • turbocharged engines • combustion systems.

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New power shift transmissions • final drive arrangements • transmissions • clutches • hydraulic circuit components.

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Engines • systems • wheel and crawler tractors • transmissions • vehicle configurations • earthmoving machinery.

SEND RESUMÉS TO:
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Professional and Technical Employment

CATERPILLAR TRACTOR CO.
PEORIA, ILLINOIS

PARATONE 400 SERIES

MULTI-FUNCTIONAL VISCOSITY INDEX IMPROVERS BOOST MOTOR OIL PERFORMANCE 4 WAYS!

- Improves Viscosity Index
- Essentially Eliminates Sludge Deposits
- Reduces Piston Varnish
- Reduces Pour Point

The new Paratone 400 Series, latest addition to Enjay's growing list of Prescription-Balanced Paramins, is an entirely new class of multi-functional Viscosity Index Improvers.

COMBINES FUNCTIONS OF OTHER ADDITIVES

Provides the benefits of a viscosity index improver and a pour depressant as well as providing sludge dispersancy and detergency.

FIGHTS ENGINE DEPOSITS

Motor oils prescription-balanced with Enjay's Paratone 400 Series essentially eliminate sludge deposits even under the severest stop and go driving conditions. In addition, you can market an oil assuring customers of:

- Cleaner Piston Skirts
- Clean Oil Screen
- Free Flowing Oil Supply

COMPLEMENTS OTHER ADDITIVES

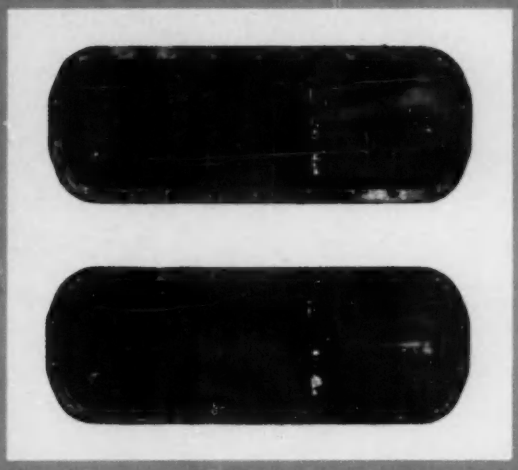
The new Paratone 400 Series may be prescription-balanced with Enjay's or other detergent inhibitors to provide an outstanding motor oil.

THOROUGHLY TESTED

Before putting Paratone 400 Series of multi-functional viscosity index improvers on the market, Enjay subjected it to the most severe laboratory and field performance tests.

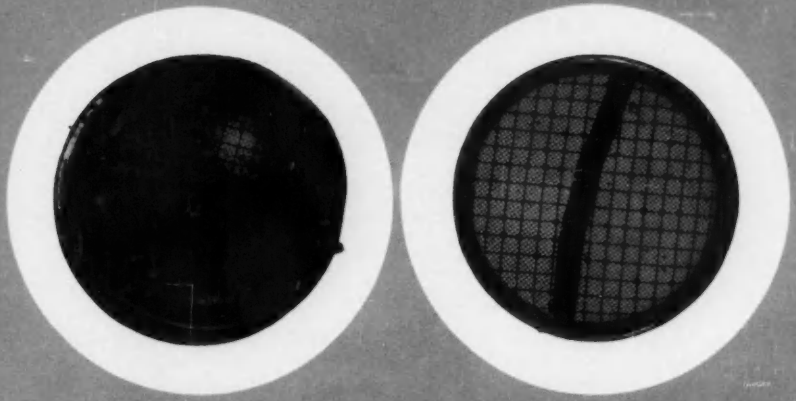
ENJAY

Toughest test of motor oil additive performance is the stop-and-go of *taxicab operation*. Enjay tests additives to their utmost in a fleet of 60 New York City cabs, under every driving condition the city can offer. Each test begins with a completely new engine, continues for over 25,000 miles with oil changes only every 4,000 miles. Engines are then pulled out, dismantled, and are carefully inspected. Paratone 400 Series additives conclusively proved their worth in these tests. For details — see below and right.



Oil pan at the top shows effect of using Paratone 400 Series additive, while the other pan shows the results with conventional viscosity index improver. The oil pans tell the story. The detergent inhibitor and the base oil used were the same.

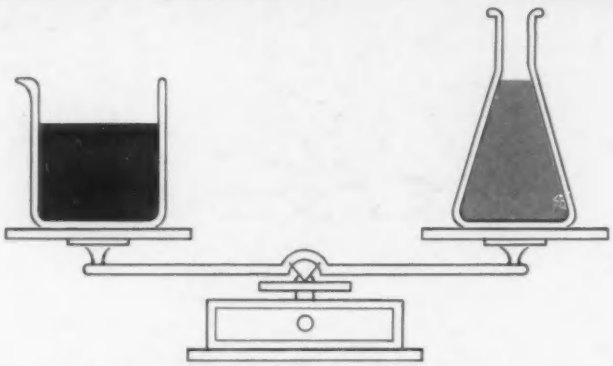
Taxi piston shows how well a Paratone 400 additive protected against ring zone deposits during the 25,000 miles.



Oil screen clogging practically eliminated! Here are two representative oil screens from the above Taxi Test. Note the dramatic difference . . . screen on the right with Paratone 400 Series additive is only 2% clogged. The clogged screen on the left resulted from an oil which contained a conventional viscosity index improver.

Up to 50% better overall sludging performance in taxi tests! You can expect this kind of result from recommended blends of Paratone 400 Series additives.

Oils formulated with the Paratone 400 Series product can easily meet the customer's specific requirements, including Ordnance qualifications.



CALL UPON ENJAY FOR PRESCRIPTION-BALANCED ADDITIVES

. . . Made to your exacting specifications . . .
Created to help you market your product SUCCESSFULLY

- Enjay serves you as a single source of the complete line of petrochemicals to improve your fuels and lubricants.
- Enjay maintains a larger technical staff devoted not only to developing new additives, but also to preparing specialized formulation to fit your specific needs.
- Quality control every step of the way from raw material to finished product is extremely important at Enjay to assure our customers of consistent high quality with each order.
- Deliveries are made from Enjay product centers throughout the country. They are expedited along the way by Enjay's new traffic control system.

The Enjay technical staff is available to help you meet your individual requirements in the additives field.

For the latest Technical Service Bulletin on the new Paratone 400 Series, or for more information on how a Prescription-Balanced Paramins Package can improve your product's performance — and effectively lower your treating costs — write or phone today

ENJAY

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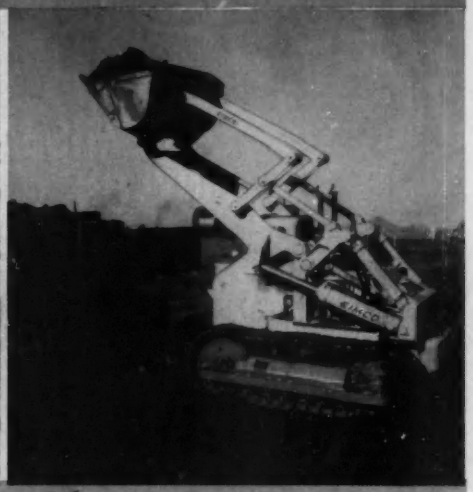
Akron • Boston • Charlotte • Chicago • Detroit • Los Angeles • New Orleans • Tulsa
EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

✔ LORAIN Moto-Loader

✔ ALLIS-CHALMERS TL-20 Tracto-Loader

✔ LeTOURNEAU-WESTINGHOUSE Haulpak



✔ EIMCO 126 Front End Loader

. . . also

- ✔ CATERPILLAR
- ✔ CLARK-MICHIGAN
- ✔ GALION
- ✔ HUBER-WARCO
- ✔ INTERNATIONAL HARVESTER
- ✔ YALE & TOWNE and others

Notice the firms now using BLOOD BROTHERS Drive Lines by ROCKWELL-STANDARD

Here are names you know—outstanding builders of earthmoving, loading and handling equipment. They must—and they do—build for brute strength, efficiency and dependability.

So it's significant that the engineers of *each firm* have independently approved one component in common: Blood Brothers Universal Joints.

Used on main drive lines, power steering assemblies and accessory p.t.o.'s, these products of Rockwell-Standard can add excellence to machines you build, too.

Contact Rockwell-Standard's engineers on your next project—their experience may save you money!

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ROCKWELL R STANDARD BB UNIVERSAL JOINTS

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For general information, request our Bulletin 557.

continued from p. 118

tards its acceptance as original equipment on new cars. It is known as nylon flat spotting. It occurs when a car stands for any appreciable length of time, and disappears after several miles of running. So far, no remedy has been found.

To Order Paper No. 84U . . . on which this article is based, see p. 6.

Physical and Chemical Ignition Delays in Operating Diesels

Based on paper by

C. W. Chiang, P. S. Myers, and O. A. Uyehara

Mechanical Engineering Department, University of Wisconsin

HOT-MOTORED AND NITROGEN techniques were used to determine rates of vaporization and chemical reaction during the ignition delay period in an operating diesel engine. Pressure-time data were obtained for different fuels and operating conditions; and estimates were made of spray penetration and temperatures.

Three pressure-time records were compared to obtain the data: (1) without either vaporization or chemical reaction, (2) with vaporization only, and (3) with both vaporization and chemical reaction.

This work continues earlier research and analysis of phenomena occurring during the ignition delay period[1,2].

Experimental Procedure

The hot-motored technique consists of obtaining two successive pressure-time records. . . . The first is a normal, fired, cycle; the second is the succeeding cycle with the injector rack

continued on p. 129

[1] "Physical and Chemical Ignition Delay in an Operating Diesel Engine Using the Hot-Motored Technique," by T. C. Yu, O. A. Uyehara, and P. S. Myers, SAE Transactions, Vol. 64, 1956, pp. 690-702.

[2] "Fuel Vaporization and Ignition Lag in Diesel Combustion," by M. M. El Wakil, P. S. Myers, and O. A. Uyehara, SAE Transactions, Vol. 64, 1956, pp. 712-729.

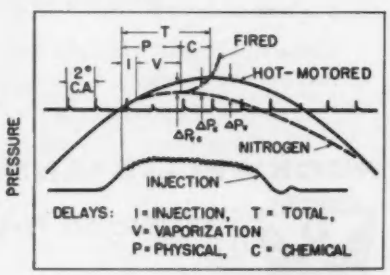

Fig. 1 — Three pressure-time records.

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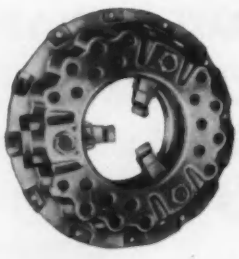

Lipe Heavy-Duty DPB Clutches are available in single and two-plate types; 12", 13", 14" and 15" sizes; with torque capacities from 300 to 1900 ft.-lbs.

LIPE ROLLWAY Lipe-ROLLWAY CORPORATION SYRACUSE 1, N.Y.

continued from p. 126

pulled back so that no fuel is injected.

The nitrogen cycle arrangement scavenges the airbox of the GM 1-71 engine with nitrogen while the fired-cycle pressure-time record is being obtained. Thus, when the inlet ports are opened the cylinder is filled with inert nitrogen for one cycle rather than air. Fuel is injected in a normal way during this cycle. Because of the necessity for complete scavenging of the airbox of all oyxgen it has only been possible to operate the engine at low (400) rpm.

Fig. 1 shows the three pressure-time records, and arbitrary definitions used for the study.

Conclusions

Computed data and analysis led to the following conclusions.

1. All evidence points to the presence of adiabatic equilibrium in the spray soon after injection starts. Adiabatic equilibrium must cease to exist, however, in the edges of the spray.

2. Different fuels and different nozzle configurations give different spray characteristics. These different spray characteristics result in different local air-fuel ratios and thus affect the adiabatic equilibrium temperature.

3. Since the physical characteristics of the fuel affect the adiabatic equilibrium temperature and the spray characteristics, and since chemical reaction rates are markedly affected by temperature, it follows that the physical characteristics of the fuel affect the chemical delay as well as the physical delay.

4. After chemical reaction has started there are differences between fuels in the rate at which the chemical reaction increases. This rate of increase is highest for high-cetane fuels and it is undoubtedly the cause of the less harsh combustion experienced with the high-cetane fuels. On the other hand, low-cetane fuels seem to have comparatively slower early reaction rates followed by very rapid reactions and harsh combustion.

5. For the small period studied (less than one-half the injection period) impingement is negligible. The fact that less heat is extracted from the air than is theoretically required for complete vaporization and superheat is due to the existence of adiabatic equilibrium.

To Order Paper No. 125U . . . on which this article is based, see p. 6.

Designs Governor For Small Engines

Based on paper by

J. W. MORSE and PETER VAN DE CARR
Curtiss-Wright Corp.

A HYDRAULIC isochronous governor has been developed for small diesel and gasoline engines which is compact, rugged, light, fast, and inexpensive. It is flexible in mount and drive requirements, operates from an external or self-contained oil supply, and can easily be complemented with load sensing equipment.

The governor has a speed sensitive control element, a power output element, and a stabilizing element. The speed sensitive element consists of flyweights which are driven as a function of speed and are counterbalanced by the force of a speeder spring to position a pilot valve which controls the

continued on p. 130

continued from p. 129

governor output shaft. At equilibrium speed, when the weights are balanced against the speeder spring, the pilot valve is positioned so that there is no oil flow. When a speed error occurs, the pilot valve directs the flow of pressure oil to the power output element to cause movement of the fuel metering equipment in a direction to correct the speed error.

Operation of Power Output Element

The power output element in the control shaft of the governor, which is linked mechanically to the fuel metering equipment of the engine. The shaft is rotated in a fuel-off direct by a piston which is constantly supplied with pressure oil and is rotated in a fuel-on position by a larger piston having a mechanical advantage. The small force signal of the speed error noticed by the flyweights thus is amplified hydraulically to produce a large force in the power output element.

The stabilizing element consists of a feedback signal actuated by the power output shaft through a pumper piston, a spring-mounted proportioner piston, and needle valve, all interconnected through a hydraulic passage to the bottom surface of the pilot valve. As the power output element moves to correct a speed error, it moves the pumper piston and applies hydraulic force to the bottom surface of the pilot valve. This force modifies the balance between the speeder spring and the flyweight force and causes the pilot valve to recenter at a new speed. The magnitude of the force is determined by the construction of the spring supported proportioner piston, the pumping piston, and the rate of return to set speed. The rate of return is controlled by the flow of hydraulic fluid through a needle valve orifice.

To Order Paper No. 122W . . . on which this article is based, see p. 6.

All Types of Radar Used in Guidance Systems

Based on talk by

WILLIAM H. BARNETT

Raytheon Mfg. Co.

(Presented before SAE New England Section)

THE sensing element of most air defense guided missiles is radar. All types of radar are used, from the basic pulse and continuous-wave systems to the more complex pulse-doppler and frequency-modulated continuous-wave systems. Pulse radar, the most familiar of all, yields an accurate measurement of target range by accurately measuring time of echo travel. In a tracking pulse radar we are interested in tracking the desired target to the discrimination of all others. To accomplish this a gate in the receiver is placed at the target range. It then tracks the desired echo in range discriminating against other echoes at other ranges.

The simplest form of radar is continuous wave, in which radar energy is continuously radiated toward the target and the target-reflected echo is continuously received at the radar. Energy reflected from a moving target undergoes a frequency shift proportional to the target's radial speed. This is the well-known doppler effect, which is commonly observed in the increasing pitch of the bell of an approaching train. At the radar a comparison is made between the frequency of the transmitted energy and that reflected from the moving target, yielding a doppler beat frequency proportional to the target radial speed. Echoes arriving at the radar from targets of different speeds will produce different

continued on p. 132

The viscose tire cord as advanced as the new Valiant! Today's new kind of car calls for tires to match. Chrysler Corporation shows it by putting tires made with TYREX viscose cord not only on the new VALIANT, but all of its 1960 cars. This means tires tougher than steel—stronger, longer wearing than any other cord tire in existence; cooler running, smoother riding, quieter, too... as proven by test. TYREX? Naturally. It's just like Chrysler Corporation to want the best. The Valiant, Plymouth, Dodge Dart, Dodge, DeSoto, Chrysler and Imperial all come equipped with tires containing TYREX viscose tire cord . . . for more tire power.

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*TYREX Inc., Empire State Bldg., New York 1, N.Y. *TYREX is a collective trademark of TYREX Inc. for viscose tire yarn and cord. TYREX viscose tire yarn and cord is also produced and available in Canada.*

continued from p. 130

doppler frequencies. Again in a tracking radar it is desirable to discriminate against all but the desired target. As might be supposed in this case, it is done by a gate, which tracks the target in speed.

The pulse radar basically yields range information, and the constant-wave radar, speed; extensions can be made to both to yield both range and speed. The pulse radar does this by making use of the doppler principle, in which case it is termed a pulse-doppler radar. The constant-wave radar does it by using frequency, rather than amplitude modulation of the radar energy, in which case it is termed frequency-modulated continuous-wave radar.

Hydrostatic Drive Proves Top Performer

As design and manufacturing skills increase and as transmission performance requirements become more exacting, the hydrostatic transmission will surmount cost barriers and become preeminent in the agricultural and industrial machinery fields.

Hydrostatic transmissions have certain unique advantages. Among these are:

1. Full reversibility from the full design rpm in one direction, down to zero rpm, and then to full design rpm in the other direction. This reversibility is completely smooth.
2. High efficiency over a wider range of operating conditions than other transmissions.
3. No creep and no tendency to creep at zero delivery of pump.
4. Complete overload protection of engine and any auxiliary gears or shafts in the power train.
5. Faster acceleration, deceleration, and reverse than any power-transmission system.
6. High degree of flexibility of installation.
7. Dynamic braking can eliminate conventional brakes.
8. Constant speed regardless of load

THIS article is based on the following papers:

"Hydrostatic Transmissions for Vehicles" by E. H. Bowers, Dowty Hydraulic Units, Ltd. (Paper No. 92V)

"Hydrostatic Transmissions" by P. C. Mortenson, Vickers, Inc. (Paper No. 92U)

To Order Papers No. 92U and V on which this article is based, see p. 6.

continued on p. 134

Nothing says Quality like the 1960 De Soto

the best reason why it pays to be a De Soto Dealer

continued from p. 132

or terrain. If drawbar load is removed suddenly, vehicle speed remains unchanged.

There are problems connected with hydrostatic transmissions which remain to be solved. These are:

1. Noise can be troublesome when the units are required to operate over wide speed and pressure ranges.
2. High efficiencies require precision materials and workmanship.
3. Weight and bulk may exceed those of mechanical transmissions for a given horsepower rating.
4. Cannot compete as yet with other forms of mechanical transmission on a dollar-per-horsepower basis.

GUST FATIGUE DAMAGE

predicted by power spectral analysis and constant life curves

Based on paper by

Robert H. Games

El Segundo Division, Douglas Aircraft Co.

AIRCRAFT wing gust fatigue damage can be predicted by power spectral analysis and constant life fatigue curves.

Power spectral analysis predicts aircraft wing experience in terms of oscillatory bending moment. In this technique, atmospheric turbulence is represented as a continuous random disturbance — denoted by power spectral density functions and probability distributions. Detailed information is needed on the spectrum of turbulence and its variations . . . for which there is an analytical expression.

Gust history is reduced to specifying the probability distribution of the rms gust velocity at each altitude. The probability distribution is determined from peak acceleration counts.

For discrete intervals of rms gust velocities, the response history, or average number of positive maxima per hour exceeding a given value of response quantity is assumed. Solution is by an electronic computer.

Representing Fatigue Characteristics

Airplane loading experience is varied and includes that due to landings or ground-air-ground cycling, and maneuvers, as well as gust loading. These conditions impose loads varying in load ratio. Therefore, an extensive representation of the fatigue characteristics of the area to be evaluated is essential. These characteristics are represented by constant life curves determined by fatigue testing or estimated from past experience, using published curves.

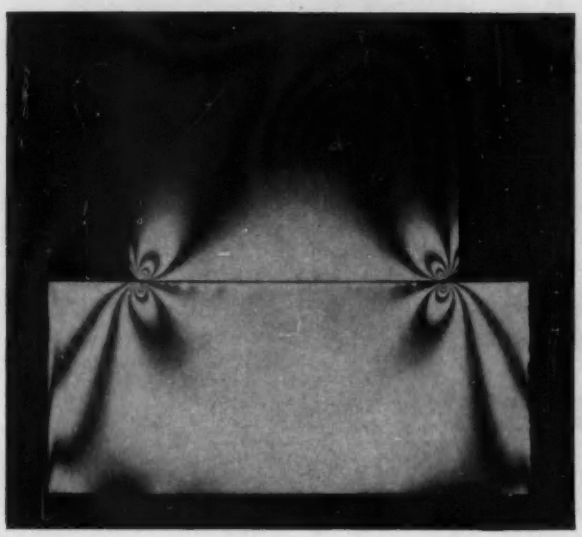
If a test spectrum is assumed equivalent to all types of loading, the wing is

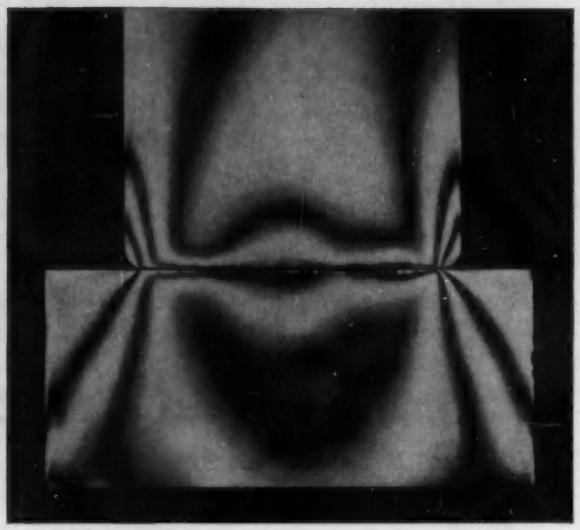
continued on p. 136

One in a series of technical reports by Bower

BEARING BRIEFINGS

ROLLER BEARING LIFE AND CAPACITY LINKED TO STRESS DISTRIBUTION





These reproductions of photoelastic studies contain important evidence for every engineer and designer concerned with the performance and selection of roller bearings. In these photographs, the alternate dark and light areas, called fringes, indicate not only the magnitude of stress but also the stress distribution. The photographs were taken by Bower Research Engineers during a study of stress distribution in roller bearings.

The subjects represent rollers and raceways of two roller bearings under identical loads. The illustration at the left shows a roller of conventional design. The illustration at the right shows a Bower "Profiled" roller. That is, the roller is precision ground with a large radius generated along the body of the roller—a predetermined and controlled distance from each end.

The conventional roller photo (left) clearly shows how, under load, stress concentration builds up in and near the roller ends. This is called edge-loading. Such areas of concentrated stress are the breeding grounds for metal fatigue and eventual bearing failure.

In the photo of the "Profiled" roller (right) stress lines can be seen uniformly distributed across the whole length of the roller and raceway. There are no points of excessive stress concentration, consequently no starting points for early fatigue. Such a "Profiled" roller exhibits a great advantage in improved load carrying capacity, a most important bearing requirement.

Under actual operating conditions, Bower "Profiled" roller bearings show a considerably longer life at higher speeds and under greater loads than conventional roller bearings.

Because of this, and of other Bower features to be discussed in later technical reports, we suggest that you consider the advantages of Bower bearings in satisfying your future bearing requirements.

★ ★ ★ ★

Bower engineers are always available, should you desire assistance or advice on bearing problems. Where product design calls for tapered roller bearings or journal roller assemblies, Bower makes these also in a full range of types and sizes.

BOWER ROLLER BEARINGS

BOWER ROLLER BEARING DIVISION — FEDERAL-MOGUL-BOWER BEARINGS, INC., DETROIT 14, MICHIGAN

continued from p. 134

repeatedly cycled and test life noted.

Then the constant life curves representative of the critical area are developed as follows:

1. Local stress-raisers are neglected and the resultant uniform stress determined for the load conditions to which the wing was tested.

2. A stress concentration factor is assumed representative of the critical area. (A factor of five agrees with fatigue experience of many conventional rib-stringer wings.) From published constant life curves, the applicable *S-N* curve is drawn and resultant fatigue life calculated by means of Miner's theory of cumulative damage. An *S-N* cruve representative of the area is determined by multiplying the assumed curve by the ratio of the test life to that calculated. This shifts the assumed curve to where it now represents fatigue test behavior of the wing.

3. The appropriate *S-N* curve is now superposed upon the assumed constant life curves, along the vector of constant minimum stress, by selecting points from the *S-N* curve of similar lives. The new or shifted curves of constant life are faired through the known points and extrapolated by assuming a profile similar to that of the known constant life curve for the stress concentration factor.

The resultant constant life curves represent the fatigue characteristics of the critical area of the wing from which an *S-N* curve may be determined for any required ratio of loading.

Fatigue Damage Due to Gusts

For level flight, superposed gust damage is evaluated by determining the *S-N* curve for a constant mean stress from the representative constant life curves. Load experience is converted to load occurrences at each mean value of bending moment and evaluated with the aid of Miner's theory of cumulative damage.

Where the aircraft flight experience includes gust loading at various altitudes and speeds as well as superposed maneuver loading, a separate response calculation is necessary for each interval of assumed steady state condition. However, the constant life curves are adequate to evaluate damage due to all significant ratios of loading.

(The paper from which this article was taken explains the gust fatigue damage prediction method in more detail — and includes equations, tables, and charts. As an example, the effects of gust loading and aircraft wing response at sea level and 550-knots flight speed are predicted using this method.)

To Order Paper No. 108W
on which this article is based, see p. 6.

Split Torque Transmissions Compared

Based on paper by

PETER BLOCH and RAYMOND C. SCHNEIDER
Twin Disc Clutch Co.

FOR true split torque arrangements, the following advantages and disadvantages in comparison to straight converter drives may be listed:

Advantages:

1. The peak efficiency is increased.
2. The economy ratio is increased.
3. The converter size is reduced to 50%, depending on the magnitude of split ratio and converter match.
4. The engine speed is reduced as transmission stall is approached.
5. Some mechanical inertia effects are available which can be useful for various applications, but fluid drive smoothness is still maintained.
6. On sustained type converters, the

continued on p. 139

One of a series

The revealing face of an iron crystal

A single crystal is an ideal system for studying the solid state. Physicists at the General Motors Research Laboratories have turned to whisker-like growths of nearly perfect single iron crystals to investigate three intriguing phenomena: magnetic domains, dislocation defects, and—more recently—high temperature oxidation.

In this latest study, the two crystallographically different surfaces found on iron whiskers are being used to examine the anisotropy or axial-dependent nature of the oxidation process. In early stages of oxidation, the oxide patterns that form on clean surfaces have been found to be strongly dependent upon the orientation of the underlying crystal. In later stages of oxidation, tiny oxide "cilia" actually grow on the surface of the iron whisker. But these new whiskery forms of oxidation are no longer related to the crystal's surface arrangement. The next step in this program involves correlating the oxidation behavior with lattice structure defects such as vacancies and dislocations.

This type of solid state research is revealing the atomic processes underlying strength, magnetic characteristics, and corrosion resistance of metals. At GM Research, we believe the solution to practical problems is increasingly dependent on fundamental information such as this. And each solution enables us to continue to provide "More and better things for more people."

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From this research will come better prepared engineers and new ideas to help make the automobiles of tomorrow better in every way.

Naturally, with the busy schedule mapped out for it, the laboratory itself must be rugged and durable. That's why the designers specified nickel stainless steel for the lab's exterior, and for so much of its interior.

The properties of nickel stainless steel – its strength, its scratch, dent and corrosion resistance, its ease of fabrication – give it practically unlimited application possibilities. Perhaps you have styling or structural problems that could be best solved by this versatile nickel-containing metal. If so, INCO will be glad to work with you to help solve it.

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MAKES STAINLESS STEEL PERFORM BETTER LONGER

continued from p. 136

power absorption at low load — high speed conditions is reduced.
7. The planetary gear can be used for an overdrive or other purposes.

Disadvantages:

1. The availability ratio is reduced.
2. The stall torque ratio is reduced.
3. There is less downhill braking available.
4. The design is more complicated; there are additional elements which compensate for the reduction of converter size.
5. The additional losses in gears and clutches may overcome the theoretical efficiency gains.
6. Torsional vibrations may occur in the drive line because there are additional elements connected to the engine flywheel which are damped by the converter.

For recirculative systems, the following features are different:

Advantages:

1. The stall torque ratio is increased for output splits, at least within certain limits.

Disadvantages:

1. The peak efficiency is reduced.
2. The economy ratio is reduced.
3. The converter size is increased.
4. The engine speed is reduced as high transmission speed ratios are approached.

A mathematical investigation of hydrodynamic split torque transmissions as well as actual performance characteristics of various split torque transmissions, upon which the above conclusions are based, is available in paper 93T.

To Order Paper No. 92W . . . on which this article is based, see p. 6.

Cold Facts About Transmission Oils

Based on paper by

R. E. CROSTHWAIT and W. F. GREENAWALT

Socony Mobil Oil Co., Inc.

FIVE facts regarding low-temperature automatic transmission fluid have been gleaned from Brookfield viscosity tests. These are:

1. Automatic transmission fluid low-temperature viscosity behavior is best studied in fully formulated blends containing all of the components of the balanced fluid.
2. Lighter viscosity base oils offer the best low-temperature fluidity.
3. Equivalent automatic transmission fluid viscosity characteristics can be obtained with widely different mineral base oils.
4. V.I. improvers are one of the ma-

continued on p. 145

DYNAMIC DIFFERENCE

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Valve: optional; internal relief, adjustable 800 - 1500 psi

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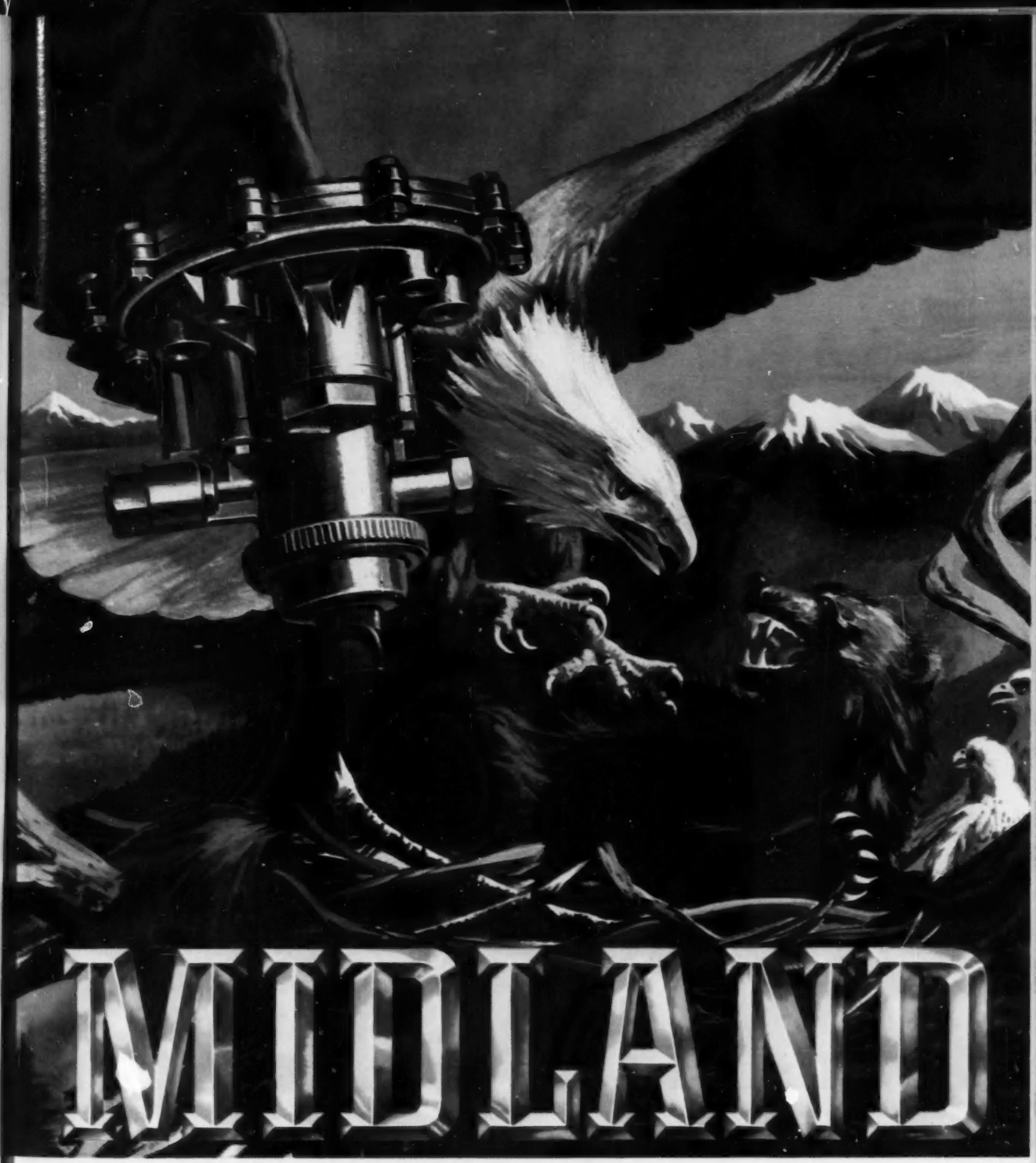
Photo from Worthington Mower Company, Stroudsburg, Pa., a subsidiary of Jacobsen Manufacturing Co., Racine, Wis.

Franklin adv. H-118



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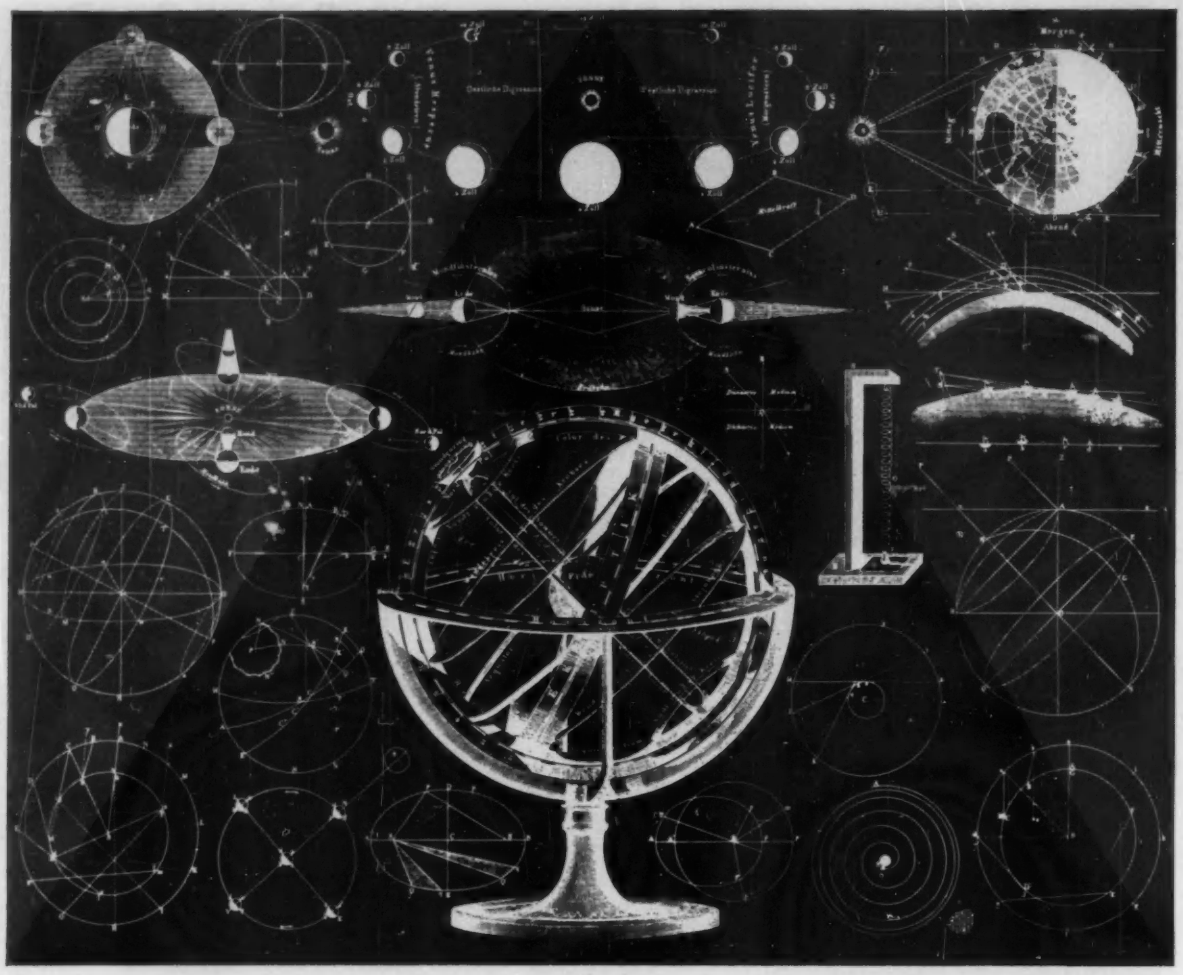

Guided tour of the solar system

The new NASA Thor-boosted research rocket, DELTA, now being constructed by Douglas, will set up big signposts for further space explorations. Combining elements already proved in space projects with an advanced radio-inertial guidance system developed by the Bell Telephone Laboratories of Western Electric Company, DELTA will have the versatility and accuracy for a wide variety of satellite, lunar and solar missions. Douglas insistence on reliability will be riding with these 90 foot, three-stage rockets on every shoot. At Douglas we are seeking qualified engineers to join us on this and other equally stimulating projects. Some of our requirements are listed in our column on the facing page.

Maxwell Hunter, Asst. Chief Engineer—Space Systems, goes over a proposed lunar trajectory with Arthur E. Raymond, Senior Engineering Vice President of DOUGLAS

MISSILE AND SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ DC-8 JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND SUPPORT EQUIPMENT

continued from p. 139

jor factors controlling low-temperature viscosity.

5. Detergents, anti-oxidants, and antisquawk agents have a minor additive effect on viscosity. In general, they increase the viscosity of the base oil/V.I. improver combination.

To Order Paper No. 124U . . . on which this article is based, see p. 6.

Weight Transfer Boosts Tractor Work

Based on paper by

ROY W. JOHANSEN
Allis-Chalmers Mfg. Co.

WEIGHT transfer with limit, applied to a semi-integral implement mounting, increase the tractive efficiency of farm tractors and enables them to pull heavier and greater work-capacity implements.

The mounting has a single combination pull and load-sensing hitch point. Lift arms transfer weight to the tractor, but carry only a portion of the implement transport weight. The balance of the weight is carried by an implement transport wheel actuated by a remote ram mounted on the implement and controlled by an automatic hydraulic valve.

When plowing, the tractor single hitch-point, load-sensing spring and linkage measures the load and causes the hydraulic system to increase or decrease the amount of implement and soil weight supported by the lift arms. The weight transfer is automatically increased or decreased to match tractive ability to drawbar loads.

Fig. 1 relates the quantity of weight transfer to the horizontal distance of the weight application point behind the centerline of the tractor rear wheels. As the horizontal distance is increased, the amount of weight transferred from the implement is decreased, while the amount of weight transferred from the tractor front wheels is increased. The curves are plotted for both 1000 psi (first stage) and for 2000 psi tractor lift arm ram hydraulic pressures.

Weight distribution is illustrated in Fig. 2. The example poses a tractor weighing 5780 lb with 1780 lb of its weight on the front wheels and 4000 lb carried on the drive wheels. It is pulling a 5-bottom, moldboard plow at an average drawbar pull of 3500 lb and a limited weight transfer hydraulic pressure of 1000 psi operating the tractor lift arms at 90% efficiency.

The maximum weight transfer to the drive wheels of the tractor, exclusive of dynamic efforts, is 1823 lb. This, added to 587-lb transfer, due to the

continued on p. 147

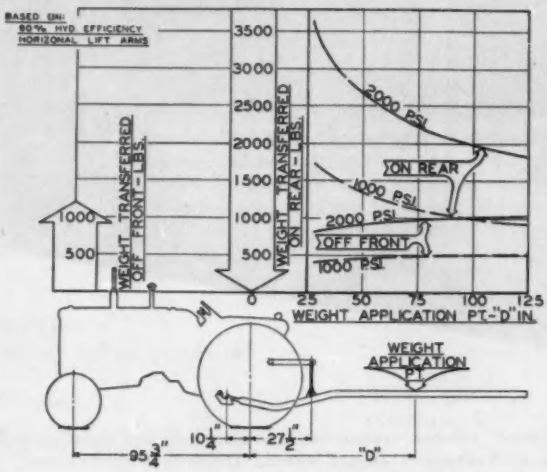

Fig. 1 — Location of the vertical articulation, or weight application, point as close to the lift links as practical, results in the most efficient use of implement weight to increase tractive effort of a farm tractor.

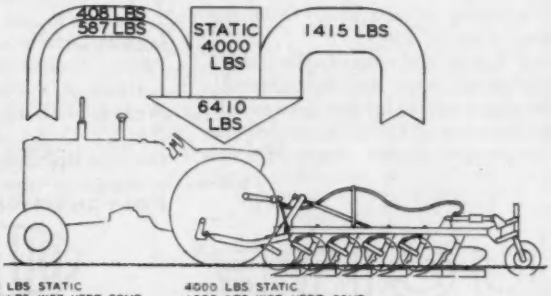

Fig. 2 — With a semi-integral implement mounting, weight can be transferred from tractor front wheels and the implement to the drive wheels of the tractor to increase traction.

continued from p. 145

horizontal component of the drawbar pull, results in a total added weight of 2410 lb on the tractor drive wheels — a 60% increase as compared to the no-load condition. Meanwhile, weight on the front wheels has been changed from 1780 to 785 lb, reducing front wheel rolling resistance. Weight transfer from the tractor front end, as well as from the implement, has thus been limited, producing a stable tractor-implement combination.

To Order Paper No. 96V . . . on which this article is based, see p. 6.

Nuclear Device Aids Soil Compaction

Based on paper by

H. A. RADZIKOWSKI
and
J. J. LAING
Bureau of Public Roads

A NUCLEAR test instrument for determining both density and moisture content of soils during highway embankment compaction has been developed by the Michigan State Highway Department.

The nuclear gage employs a radium-D-beryllium radioactive source mounted in a stainless steel casing approximately 10 in. square and 2 in. thick which rests upon the ground to make a nondestructive test. The radioactive source produces a radiation of gamma and neutron rays into the material to be measured. These rays are partially absorbed and partially reflected. The reflected rays pass through Geiger-Miller counter tubes in the surface gage and are then amplified and transmitted through an electronic circuit. Counts per minute are read directly on a reflected ray counter gage. Counts per unit of time are related to density and moisture by means of calibration curves.

The nuclear method offers the following advantages:

1. The consistency of results is increased through reduction in the human element.
2. Density tests can be performed on large sized aggregate base courses and on frozen material. This is impractical with conventional methods.
3. Greater speed and closer control over quality effects a monetary saving.

To Order Paper No. 89U . . . on which this article is based, see p. 6.

New Members Qualified

These applicants qualified for admission to the Society between October 10, 1959 and November 10, 1959. Grades of membership are: (M) Member; (A) Associate; (J) Junior.

Alberta Group

William James Cooke (J).

Atlanta Section

Sam B. Howard, Jr. (J), Jack D. Lane, Jr. (J), Terry Alfred Rush (J).

Baltimore Section

Truman Alfred Keeney (M).

Buffalo Section

Clarence Roy Little (J), William C. Platko (M), Benjamin Snyder (M).

Central Illinois Section

Wayne Phillip Meyer (J), Gerald Francis Molloy (J).

Chicago Section

David L. Anthony (J), Arthur Lyle Bloomfield (M), Leonard Dexter (M), Leonard D. Lloyd (J), John J. Lynn (J), K. R. Seshadri (J), Richard E. Stern (M).

Cincinnati Section

James E. Mann (A), William E. Mayeros (J).

Cleveland Section

Edward J. Cole (J), James Paul Lucas (J), Dr. R. S. Ross (M), A. C. Triplet (A).

Dayton Section

Jon Elwood Miller (J).

Detroit Section

Joel G. Bussell (J), Gordon C. Cherry (J), Albert R. Chick (M), Erwin O. Clark (M), Joseph C. Coyne (A), Joseph C. Craig (A), Robert Thomas Currin (M), Donald LaRue Davidson (A), Dale E. Dawkins (J), Elmer Howard Diedrich (M), Raymond J. Fiedler (J), Burley Gray (M), Lewis E. Henyon (J), Richard A. Higginbottom (J), Orron E. Kee (J), Robert C. Lendt (M), Louis Marick (M), Robert W. McMinn (J), Donald Richard Mentlikowski (J), David Richard Moore (J), Erving Nielson (J), Carleton L. Pierpont (A), Harry G. Pilarski, Jr. (J), George Puia (M), Vernon Schafer, Jr. (M), John Eugene Schmitt (J), W. J. Skutnick (M), Jay W. Smith (A).

Fort Wayne Section

Jimmie Dan Pinney (J).

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New Members Qualified

continued from p. 147

Hawaii Section

Robert Austin Silverman (A).

Indiana Section

Paul C. Kline, Jr. (M), N. Peter Lavengood (J), Robert H. McIntyre (M), Joe Brook Mechem (J), Lawrence Van BusKirk (J).

Metropolitan Section

Hugo Buechelmaier (A), Stephen C. DaCosta (A), Harold E. Deen (M), Robert McKay 3rd (M), Gilles X. Mellet (A), William Richard Niehaus (A), Paul Pagiotas (J), John Robert Provost (A), Robert L. Swick (M), Ansel E. M. Talbert (A).

Mid-Michigan Section

John L. Flitz (M).

Milwaukee Section

Robert H. Beaty (A), Myron M. Fiedler (J), Edward Kriesmer (J), Nallana Suryanarayana Murthy (J), Jerry J. Pok (J), Frank A. Spexarth (J).

Montreal Section

James Alexander Henderson (A), John Lusk (M).

New England Section

Robert J. Hamilton (M).

Northern California Section

Richard LeLand Earl (J), Ford J. Ellis (J), Aldo Mario Germano (J), James K. Goodwine, Jr. (J).

Northwest Section

George Edward Eaton (J), Robert M. Murphy (J).

Ontario Section

Joseph Michael Dabrowski (J), Thomas Duncan Graham (J), Allan Wallace Stewart (A).

Philadelphia Section

Richard O. Berkwitt (J), Edward K. Shea (A).

Pittsburgh Section

Robert L. Felt (M), John Paul Fiala (J), DeVere V. Lindh (J), Carl Stanley Walton (M).

Rockford-Beloit Section

Raymond E. Stokely (M).

St. Louis Section

Donald F. Salzmann (A), Carl Alfred Wellenkotter (J).

continued on p. 151

WHITE'S new 5400 Super Hauler

has everything designed for lightweight ruggedness *including a 9-speed transmission by Clark*

Just introduced to the American trucking industry, White's new 5400 Super Hauler sets a new high in tractor design. In a cab only 50 inches long, components are of strong, light fiberglas, aluminum, and chrome-manganese steel. Offered as standard equipment, its power train includes the efficient new Clark 9-speed transmission.

This transmission makes a major contribution to the Hauler's light weight and safe easy handling. With all major castings made of aluminum, weight savings of approximately 200 lbs result over comparable transmissions. Its offset drive minimizes propeller shaft angularity, permits the close-coupled tractor and from 1 ft to 4'4" more payload room. Fingertip air-assist removes most of the effort of gear shifting, yet retains feel; driver is in complete control at all times. Thus fatigue is reduced, safety increased, and because Clark's power-assist shift needs no extra air tanks, costs and weight are further reduced.

Drive the new White 5400 with its new Clark 9-speed transmission and you'll see what we mean.

Other Clark transmissions are available for tractors and trucks in a wide range of capacities. Write for full details.

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AUTOMOTIVE DIVISION
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See us at Booth #48-49, SAE SHOW, Jan. 12-16, Sheraton-Cadillac Hotel, Detroit, Mich.

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POLYCHEMICALS DEPARTMENT

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BETTER THINGS FOR BETTER LIVING . . THROUGH CHEMISTRY

New Members Qualified

continued from p. 148

San Diego Section

Donald D. Britt (J), Thomas Allen Drew (J).

Southern California Section

William Robert Dildine (J), Lawrence D. Ellis (J), Stanley E. Franklin (A), William J. Galli (J), Richard Joseph Gardner (M), Phillip C. Lee (J), Charles Jackson McGlinchey (J), Richard Frank Press (J), William Allan Strong (J), George K. Tabata (J), Paul E. Thornton (A), Bryn Jhan Van Hiel, II (J).

Southern New England Section

Bryan Betz (J), Fred Henry Michelsohn (J), Richard Polk Vaughan (J).

Syracuse Section

Ronald W. French (J).

Twin City Section

Albert E. Reske (M), Morris D. Wisti (J).

Virginia Section

Donald Davis (A).

Washington Section

John Burton Harrison (J), Clifton G. Wrestler, Jr. (J).

Western Michigan Section

Charles F. Rodgers (A), George Richard Wilson (J).

Wichita Section

Loyal G. LaPlante (J).

Williamsport Group

Charles Hazard (J).

Outside Section Territory

Hedley R. Colby (M), James Peter Doering (J), John P. Evert (J), Capt. William J. Hart, Jr. (M), John Harold Slike (J), Major Charles Carrington Stewart (M).

Foreign

Franz Josef Hendriksen (A), West Indies; Donald Gillan Hobson (M), England; James A. Hulme (M), West Indies; Calvin Harry Johns (M), Argentina; Luiz Meth (J), Brasil; Friedrich Ph. Wunderlich (M), Germany.

Applications Received

The applications for membership received between October 10, 1959 and November 10, 1959 are listed below.

Atlanta Section

George Radnoti, Cato Wilson

Baltimore Section

William A. Gray, Michael W. Payst

British Columbia Section

W. H. Craig, Ronald Gordon MacKenzie

Buffalo Section

Franklin A. Higgins, Fred B. Ray, Raymond E. Seekins

Central Illinois Section

James N. Brentz, Donald C. Dowdall, Stephen F. Glassey, Stanley Patrick Mallery, Ralph Tegg, Jr., Richard J. Zych

Chicago Section

Robert W. Andersen, Gail Gordon Barbee, Harold A. Behnken, James J. Berta, Carl T. Butler, A. L. Caney, Robert G. Chamberlain, James R. Colvert, William A. Cooper, Robert Denes, Leslie D. Dilworth, George Edward Koch, Jr., Roger Alan Pierce, George Plondke, George M. Rowles, Paul B. Shutt, Leon A. Wirt, Fred R. Zaun

Cincinnati Section

Richard L. Eubanks, Dennis P. Townsend

Cleveland Section

James W. Drew, Richard L. Gaugler, Richard L. Knight, Charles J. Parker, Joseph Anthony Saggio

Colorado Group

Harold Henry Eurich

Dayton Section

Louis F. Bolton

Detroit Section

Walter Anthony Bartkowiak, Harry G. Chassie, W. J. Clawson, Keith L. Cosner, George R. Fead, Arthur H. Fraser, Duane H. Goodsmith, Richard Gulau, Otto Habrecht, Howard W. Hall, Hollway Hubbard, Ronald A. Hunger-

continued on p. 153

Applications Received

continued from p. 151

man, Robert Edwin Joyce, Thomas L. Ketten, Sr., Robert C. Ketterer, Jr., George A. Kostka, John H. Lynn, Thomas Allen Nell, Sampson T. Noall, Jr., Hunter L. Oden, Frederick E. Pokorny, Jerry Anthony Pretti-Pavletta, Dennis C. Proctor, Raymond Rastenis, Russel O. Rice, Ralph Gordon Richardson, Claude E. Robitaille, Richard George Rupli, John Edward Sargent, Lloyd L. Schmaltz, Kenneth A. Snoblin, Robert G. Stanwood, James E. Steele, Frederick D. Thompson, Robert Earl Vanderberg, Robert F. Wheaton, Frank Lewis Williams, Alan A. Zimmermann

Fort Wayne Section

Gary A. Whitcomb

Hawaii Section

Donald K. Andrews, Gene Morgan

Indiana Section

Carl H. Wolgemuth

Kansas City Section

Clifford Gordon Cain

Metropolitan Section

Robert W. Dougherty, Richard A. Franchi, Roy D. Hutchings, Peter S. Kraus, Sterling T. MacAdam, A. Robert Marcus, Harvey R. Nickerson, John C. Piebes, Alfred J. Pierfederici, James P. Santos, William Schreiber, Robert F. Zalokar

Mid-Continent Section

Robert L. Carder, Frank D. McCreevy

Mid-Michigan Section

Benjamin Carter Benjamin, Carlisle R. Davis, Jr., Earl W. Glover, Kenneth D. Norden

Milwaukee Section

John J. Chyle, Frank J. Kunesh, Jr., Robert E. Schulz, Robert Charles Shebuski, Robert Louis Stverak, John H. Winston

Montreal Section

Carl Bruce Peters, Gerard St. Pierre, Dennis Smith

New England Section

Eugene W. McCarthy

Northern California Section

Richard M. Dawson, Daniel J. Gribbon

Northwest Section

Andrew J. Erickson, I. Grant Fowler

Ontario Section

Frank T. Carter, Fred W. Hall, Gus Szabo, Walter J. Washburn

Oregon Section

Donald Edward Russell

Philadelphia Section

Anthony Francis Benning, Thomas F. Bonfield, Donald J. Cecchini, Hans Peter Gull, Frank W. Klingner

Rockford-Beloit Section

Leonard H. Adams, Peter Bloch, Jerome J. Mueller

St. Louis Section

George A. Coward

San Diego Section

William O. Hagle, Curtis William Tritchka

Southern California Section

H. A. Armstrong, Stirling Edwin Babcock, Charles Richard Berreman, C. K. Le Fiell, Donald L. Meehan, John Nye Morgan, Frederick B. Safford, Mac Fuller Smith, Frederick G. Space, Jr., John A. Van Hamersveld

Southern New England Section

James Nelson Bagnall

Spokane-Intermountain Section

F. W. Fischer, William H. Kinzel, George Montague

Syracuse Section

Eugene Hugh Scheffield

Texas Section

Stanley E. G. Hillman

Texas Gulf Coast Section

Kenneth Lee McNemar

Virginia Section

J. T. Howell

Western Michigan Section

Lewis M. Davis, Glenn F. DePagter, Robert Edward Doe

Williamsport Group

Thomas D. Cooney

Outside Section Territory

Richard E. Anderson, James F. Bice, Jerome J. Bush, James F. Link

Foreign

Prabhat Tapan Basu, India; Paul Berliet, France; Robert W. French, South Africa; Nagalingam Kanagasuriar, India; Gerardo Lopez, Jr., Mexico; D. L. Narasimhan, India; B. Chandrasekhara Pillai, India; Paul C. Pinson, Mexico; Satish Inder Singh, India; M. Unnikrishnan, India; T. K. Viswanathan, India

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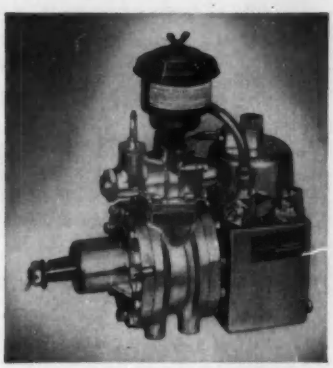
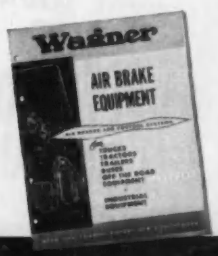
"Running an over-the-road truck fleet operation successfully depends greatly on getting the most out of the equipment you have. I specify parts and equipment on the basis of what will help lengthen the service life of these vehicles. I'm glad to tell you that when it comes to air brakes, I'll take Wagner every time. Our maintenance costs are more than satisfactory. One of the main things I like about the Wagner system is the Rotary Air Compressor. For my money it is the most efficient pump on the market."

"All-in-all, our experience and records show that Wagner Air Brakes are our best buy. I've just ordered 78 new trucks and 50 new trailers equipped with Wagner Air Brakes—what better recommendation can I give?"

Wagner Rotary Air Compressors, the only compressors that use the true rotary motion, are available in either 9 or 12 C.F.M. capacity, and in a drive-thru model for diesel-powered trucks.





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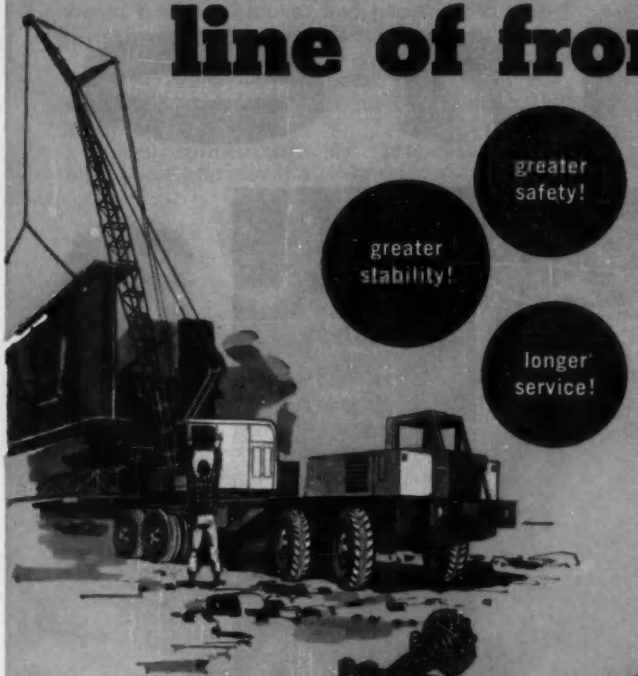

You get these three important advantages when your vehicles or equipment ride on Timken-Detroit F-900 Series Front Axles by Rockwell-Standard.

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Superior design and construction features assure better performance under all conditions. These improved front axles reduce driver fatigue . . . make steering easier . . . hold the driving path better . . . help to prolong vehicle life.

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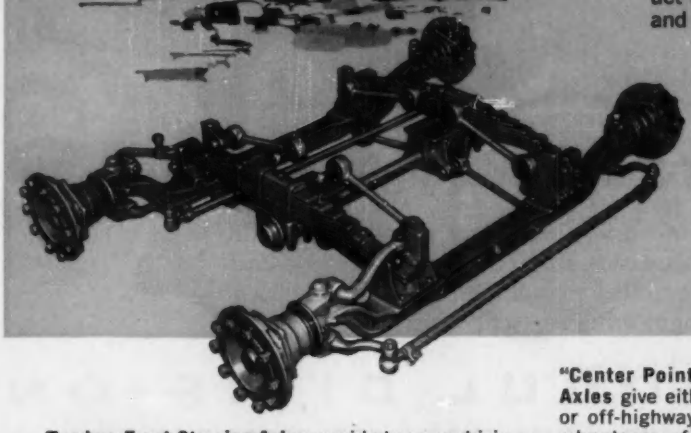

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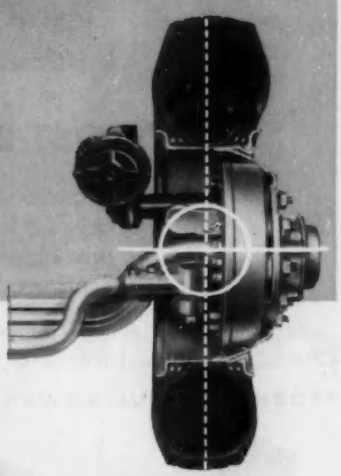

"Center Point" Steer Front Axles give either on-highway or off-highway vehicles the advantages of easy steering without the additional cost penalties of power assistance.

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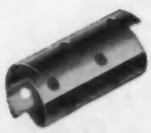
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If you are faced with the problem of torsional vibration from impulses within the operating range, Dana engineers may be able to help you solve your design problems.

Spicer resilient propeller shaft assemblies have been used successfully for years in rapid transit cars, street cars, engine dynamometer, truck, bus, earthmover and passenger car applications to solve difficult torsional problems.

Spicer rubber-cushioned shafts make it possible for design engineers to "tune out" the vibration and thus produce commercially acceptable installations.

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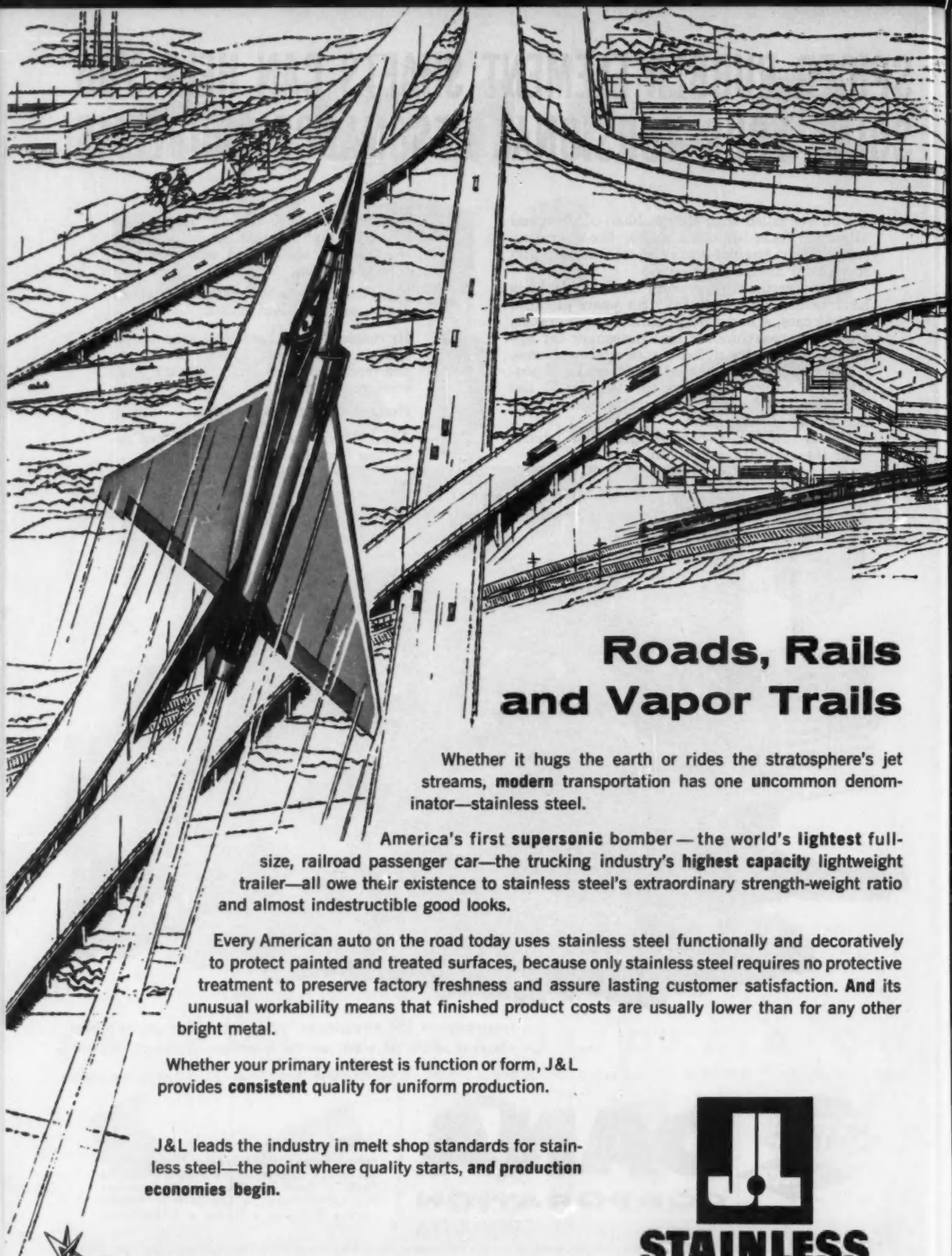

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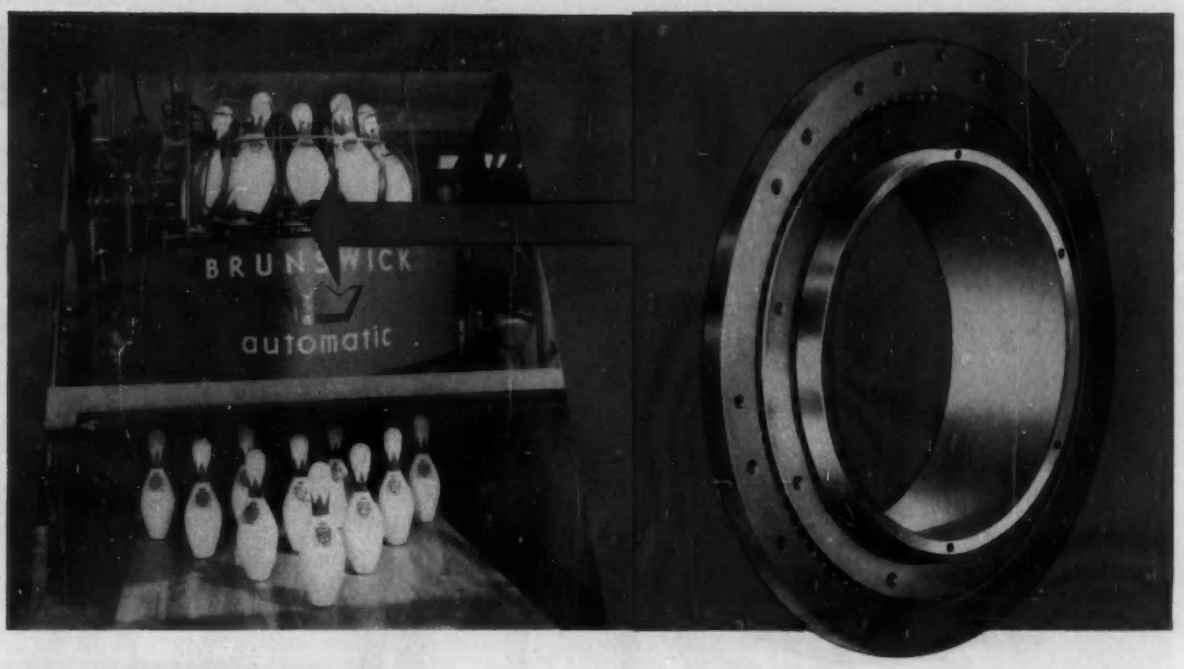

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. . . chosen for accuracy, dependability and unfailing service on an exceptionally intricate piece of equipment—a marvel of design and production ingenuity.

The entire mechanism revolves on this one bearing. After collecting and elevating the pins, they are positioned in a revolving "turret" where they are held until the last pin is received. As this last pin drops through the center of the Aetna bearing, it activates the catch mechanism and pins are released into position in the "deck." The "deck" in turn sets the pins upright with correct spacing and arrangement on the alley bed ready for bowling.

Quick, dependable performance is the key to the success and widespread adoption of the Brunswick Pinsetter. It must function perfectly, steadily, accurately—game after game, day and night—without maladjustment, breakdown or delay—and it is in just such service that Aetna Bearings prove their stamina, perfect workmanship, accuracy and dependability. Despite the fact that the pins vary slightly in weight, the Pinsetter continues to perform smoothly and accurately on its main Aetna Bearing which remains in correct alignment at all times and operates quickly, smoothly, unfailingly load after load.

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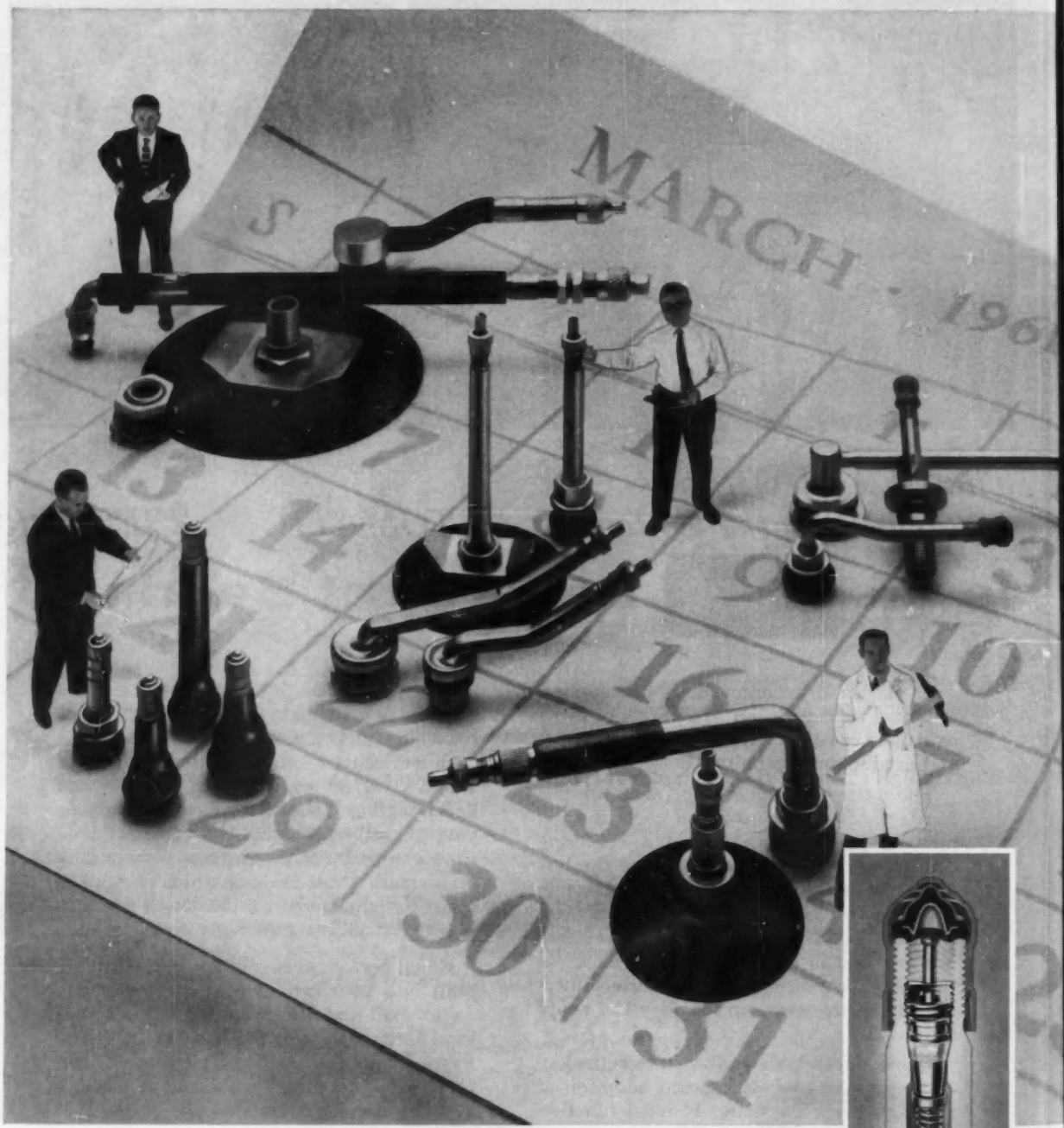

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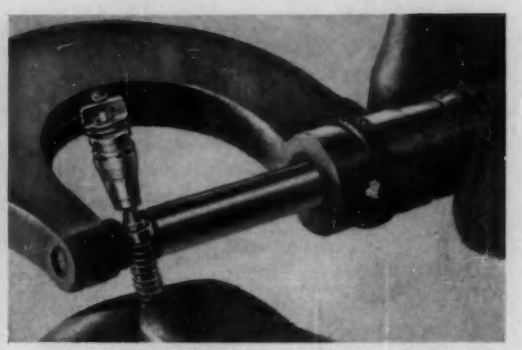

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SCHRADER VALVE CORES of 1898 fit valve housings of today with equal facility! This is the only example of world-wide standardization.

MUTUAL BENEFITS ACCRUE not only to the Automotive, Tire and Tire Valve Industries when they cooperate but to every person who rides on tires anywhere.

It just didn't happen that dependable tire and air service are taken for granted throughout the world. Many decades of cooperative design time on the part of the Automotive, Tire and Tire Valve Industries were necessary to reach our present standard . . . years in advance.

The basic fact is that nothing is too small or too large to claim the experienced attention of engineers designing all the component parts. Schrader design experts, for example, are already studying valve requirements with tire and vehicle designers and are at work on valves that will be equipment on tomorrow's vehicles.

Depend on Schrader design, production and distribution to match tire and vehicle performance anywhere throughout the world.

A. SCHRADER'S SON • BROOKLYN 38, N. Y.
Division of Scovill Manufacturing Company, Inc.

Schrader®
a division of **SCOVILL**

FIRST NAME IN TIRE VALVES

FOR ORIGINAL EQUIPMENT AND REPLACEMENT

Belly-deep in abrasives!

But it can't touch her track wheel bearings

Whatever the Oliver OC-12 is bulling through . . . liquid ooze, dirt, or gale-blown desert sand . . . nothing can get into the track wheel bearings. Oliver engineers saw to that. They specified C/R Type VS End Face Seals with metal-to-metal contact to protect those bearings. The metal faces in these seals are lapped to within 3 lightbands of being optically flat. Nothing can get in . . . and the fluid lubricant inside can't get out . . . no matter how rugged the duty. Oil seal dependability like this means fewer lube checks, fewer lube changes . . . less downtime. And *that* means big savings for Oliver users.

C/R End Face Seals are performing hundreds of other critical sealing jobs . . . saving equipment, time and money. No matter what is involved . . . high speed, temperature, pressure . . . in everything from rockets and missiles to pumps, tools and washing machines . . . there's a C/R End Face Seal for the job. If it's *your* job to solve a difficult lubricant retention problem . . . share it with us. Write for detailed information on C/R End Face Seals.

More automobiles, farm and industrial machines rely on C/R Oil Seals than on any similar sealing device.

CHICAGO RAWHIDE MANUFACTURING COMPANY

OIL SEAL DIVISION: 1243 ELSTON AVENUE • CHICAGO 22, ILLINOIS
Offices in 55 principal cities. See your telephone book.
In Canada: Chicago Rawhide Mfg. Co. of Canada, Ltd., Brantford, Ontario
Export Sales: Geon International Corp., Great Neck, New York
C/R Products: C/R Shaft and End Face Seals • Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears

C/R

Acids, Beverages, Caustics, Dyes... everything goes in Stainless Steel tankers

Cleanability of corrosion-resisting type 316 Stainless Steel gives tank trailers great hauling flexibility

Leave the home lot in the morning loaded with animal or vegetable oils, return in the evening with paint or varnish, and back on the road before daylight with a load of glue . . .

This is the kind of flexibility you can build into a tank trailer when you use type 316 Stainless Steel.

Its lasting resistance to corrosion means that many liquids—chemicals, foods, petroleum products – can be bulk transported in the same tanker. Usually, all that's needed to change from one product to another is a quick, but thorough, cleaning job.

The corrosion-resisting quality of type 316 Stainless also boosts *the service life* of the tanker. One motor transport company reports that they bought their first stainless steel tanker 20 years ago and *it's still in service.*

Easy to fabricate... economical to produce

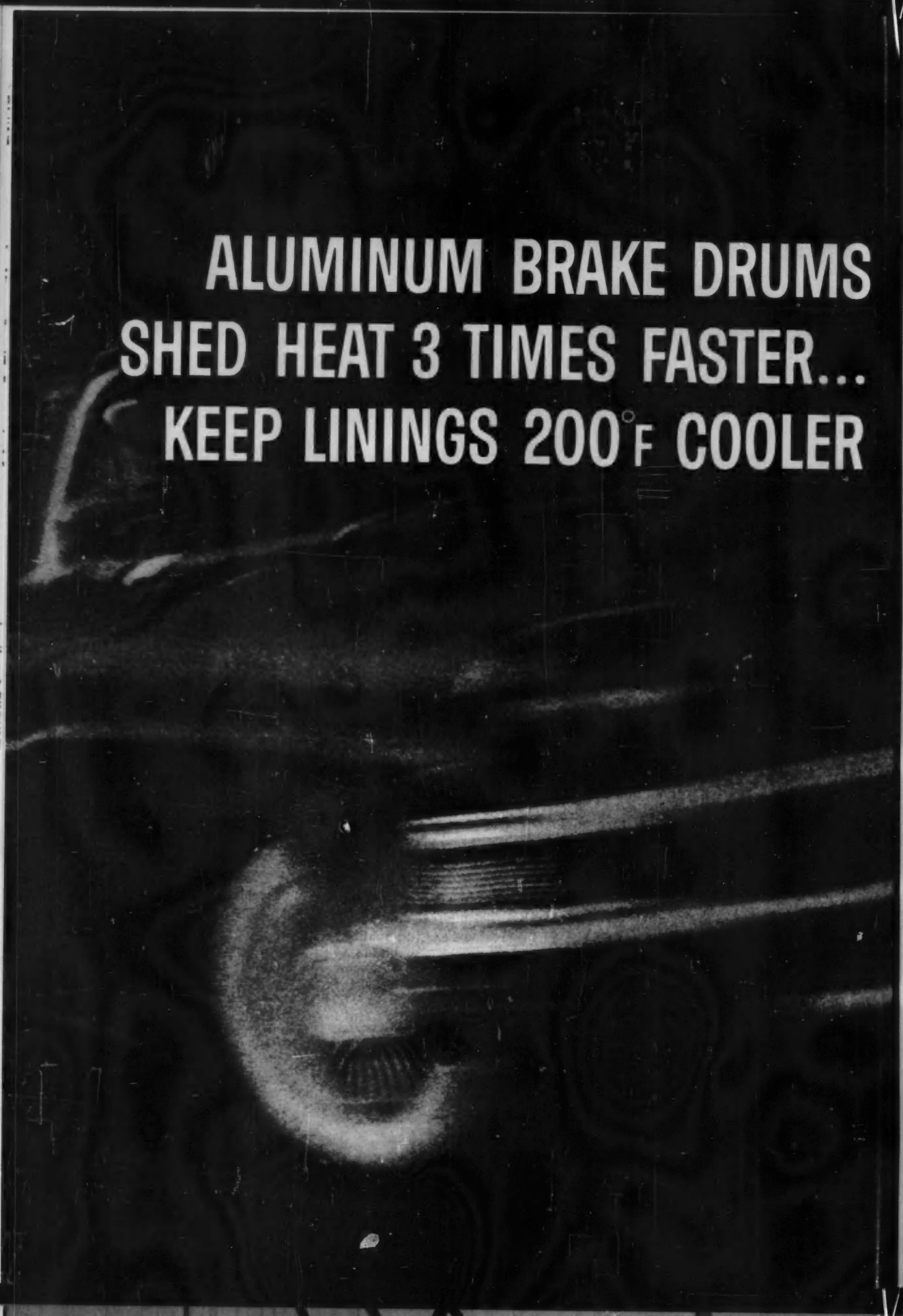
The nickel content of 316 Stainless Steel not only enhances the metal's corrosion resistance and durability, but also gives it unusual ductility and weldability . . . makes possible fast, simple fabrication . . . economical production.

If you would like more information about the superior corrosion resistance and fabricability of 316 Stainless Steel . . . as well as the specific properties and characteristics, just let us know. We'll answer any specific questions you have.

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N. Y.

INCO NICKEL

NICKEL MAKES ALLOYS PERFORM BETTER LONGER


ALUMINUM BRAKE DRUMS
SHED HEAT 3 TIMES FASTER...
KEEP LININGS 200°F COOLER

Aluminum-Silicon Alloy Brake Drum
High-silicon aluminum alloy brake drum now undergoing advanced development and testing. Evaluations show good machining, braking surface condition and braking effectiveness.

FOR SAFER, SURER STOPS

Confronted with design and performance factors that impair brake performance in the newer automobiles, engineers are turning to aluminum and Alcoa for a solution.

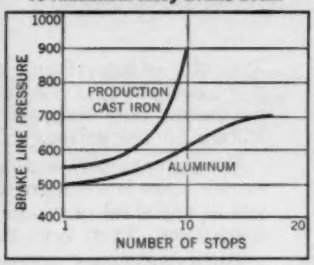
Objective: To come up with a brake drum that soaks up heat faster—throws it off faster, as well. Solution: Aluminum, with its high thermal conductivity, not only licks the critical problem of heat dissipation, but it also provides a half dozen other important advantages. Aluminum brake drums have now been standard front-end equipment, proven superior, in one major American automobile and several foreign makes for the past two years. Here's why—

Lower Operating Temperature—Compared to the production cast-iron type, aluminum drums dissipate heat three times faster to reduce brake lining temperatures by 200°F. As a result, fading is substantially reduced or eliminated, brake linings last longer, and other vital parts are protected against the threat of destructive temperatures. With lower operating temperatures come greater stability, faster recovery and freedom from rough, erratic action.

Less Weight, Better Styling—Aluminum brake drums can weigh as little as half as much as the comparable cast-iron type to reduce front-end weight. The designer's metal, versatile aluminum opens new avenues of styling possibilities. Fins and other functional or styling features may be incorporated into the aluminum brake drum.

Let Alcoa Help—Many leading manufacturers have teamed up with Alcoa's Development Division Laboratories in the exploration of new and better aluminum automotive components. The most experienced producer of aluminum in the world, Alcoa offers skilled engineers and unmatched facilities for valuable assistance to you. Bring your design and application problems to Alcoa. Write Aluminum Company of America, 1785-M Alcoa Building, Pittsburgh 19, Pennsylvania.

50-MPH FADE TEST ON AUTOMOBILE BRAKES
Production Cast-Iron Brake Drum vs Aluminum Alloy Brake Drum

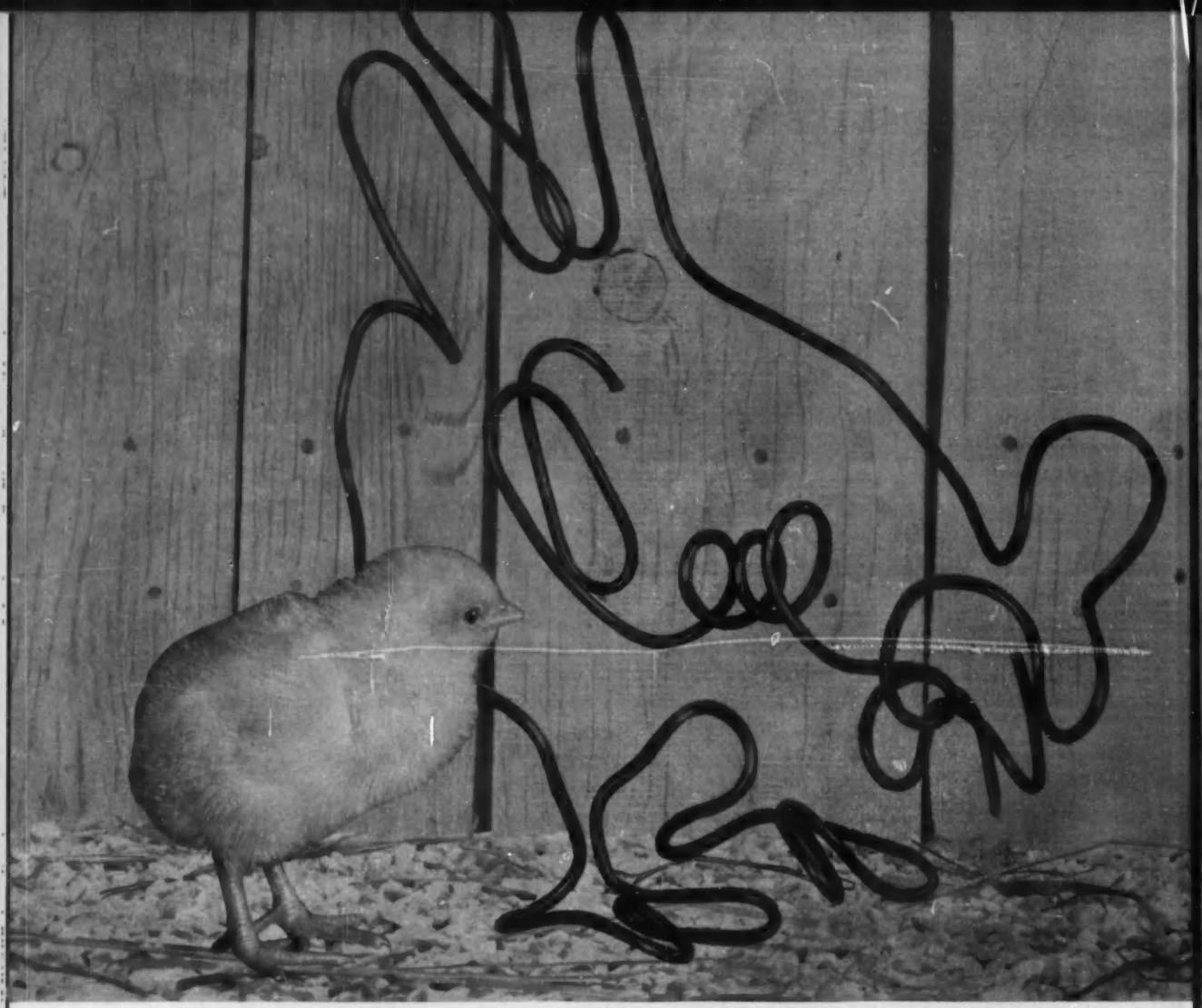


Integral Aluminum Hub and Drum Assembly
New design provides maximum exposure to air stream and optimum heat radiating area. Drum back is structural component of wheel and contributes to functional styling.

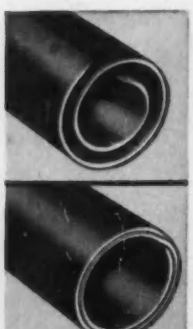
ALCOA ALUMINUM

ALCOA ALUMINUM GIVES EVERY CAR MORE GLEAM AND GO

For exciting drama watch "Alcoa Presents" every Tuesday, ABC-TV, and the Emmy Award winning "Alcoa Theatre" alternate Mondays, NBC-TV



There's almost no limit to the things Bundy can mass-fabricate



Bundyweld is the original tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.

Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high bursting strength. Sizes up to ⅝" O.D.

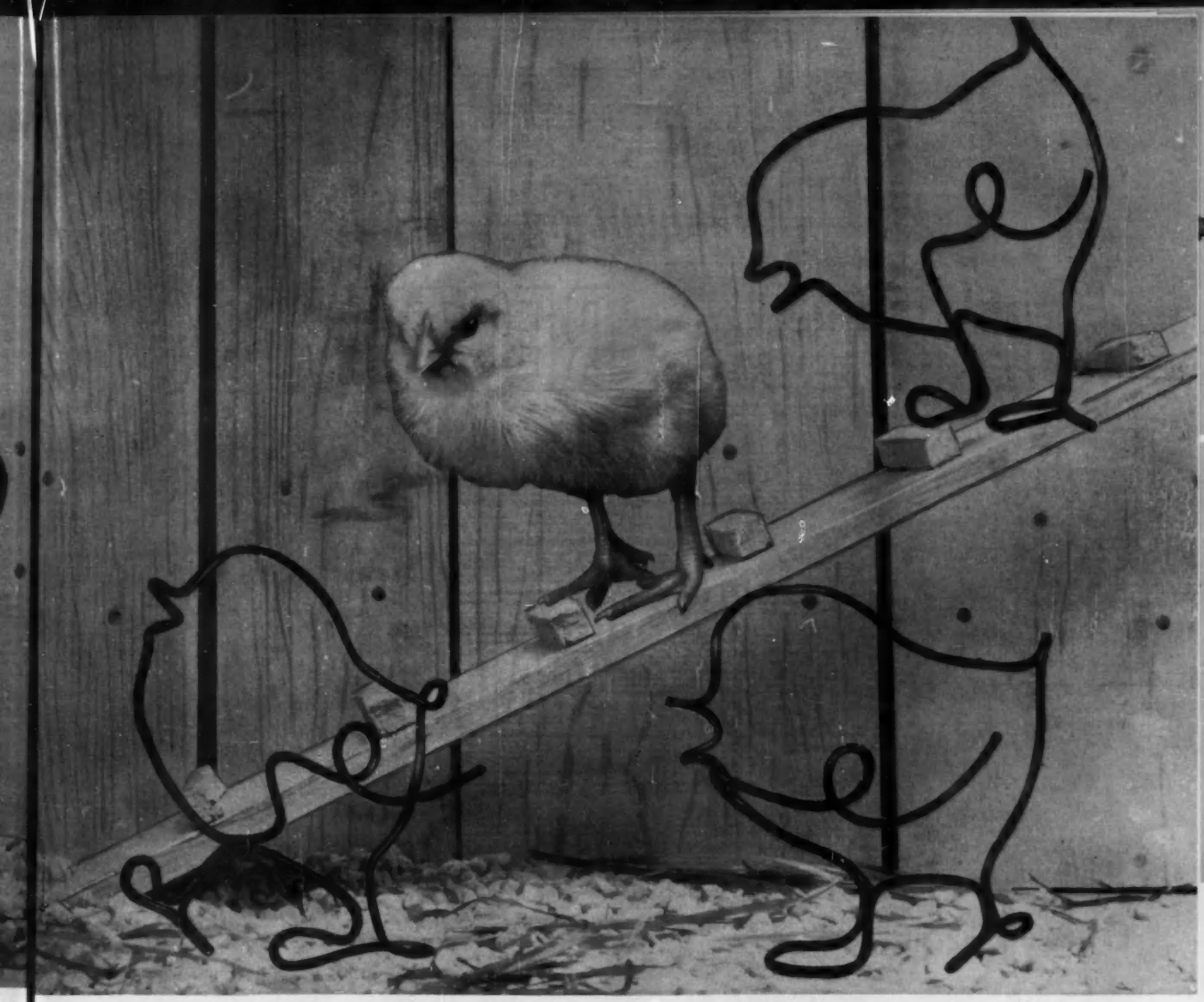
The old adage, "Don't count your chickens before they hatch," is a good one . . . but it rarely applies to Bundy. That's because, no matter how complex your tubing problem, you *can* count on Bundy for the perfect solution.

Bundy engineers and designers are backed by years of experience in the mass-fabrication of steel tubing. And they are available to you at any stage of product development for time- and money-saving suggestions. Their key: Bundyweld®!

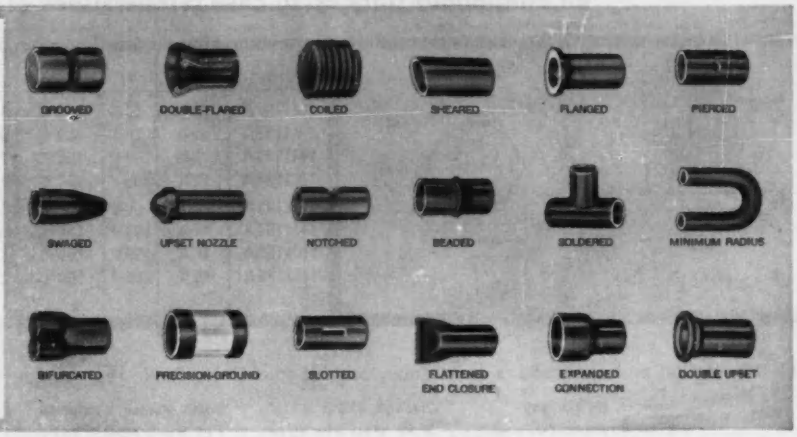
Bundyweld steel tubing is double-walled, copper-brazed, leakproof by test. Used on many applications in 95% of today's cars, Bundyweld is the tubing standard of the automotive industry. Covered by Government Spec. MIL-T-3520, Type III.

So, when you want to talk tubing, talk to the leader—Bundy! Phone, write, or wire Bundy Tubing Company, Detroit 14, Michigan.

structural component of wheel and contributes to functional styling.



No matter what type of mass-fabrication you require, Bundyweld may be your answer. Shown here are just a few tubing operations designed and fabricated by Bundy—many for use in the automotive industry.



There's no substitute for the original

BUNDYWELD® TUBING

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING • AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, AND ITALY

BUNDY TUBING COMPANY • DETROIT 14, MICH. • WINCHESTER, KY. • HOMETOWN, PA.

high burstingstrength.
Sizes up to 5/8" O.D.

Phone, write, or wire Bundy Tubing Company, Detroit 14, Michigan.

Announcing...

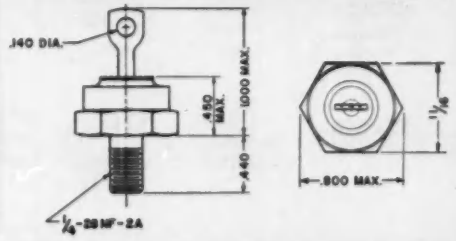
SILICON RECTIFIERS

from DELCO RADIO

High Quality
High Performance
Extreme Reliability

From the leading manufacturer of power transistors, new Silicon Power Rectifiers to meet your most exacting requirements. Even under conditions of extreme temperatures, humidity and mechanical shock, these diffused junction rectifiers continue to function at maximum capacity! Thoroughly dependable, completely reliable—new Delco Rectifiers are an important addition to Delco Radio's high quality semiconductor line.

Conservatively rated at 40 and 22 amperes for continuous duty up to case temperatures of 150°C.



TYPE	AVG. DC CURRENT	PIV	NORMAL MAX. TEMP.	MAX. FORWARD DROP	MAX. REVERSE CURRENT
1N1191A	22A	50V	150°C	1.2V at 60 amps.	5.0 MA
1N1192A	22A	100V	150°C	1.2V at 60 amps.	5.0 MA
1N1193A	22A	150V	150°C	1.2V at 60 amps.	5.0 MA
1N1194A	22A	200V	150°C	1.2V at 60 amps.	5.0 MA
1N1183A	40A	50V	150°C	1.1V at 100 amps.	5.0 MA
1N1184A	40A	100V	150°C	1.1V at 100 amps.	5.0 MA
1N1185A	40A	150V	150°C	1.1V at 100 amps.	5.0 MA
1N1186A	40A	200V	150°C	1.1V at 100 amps.	5.0 MA at 150° C case temperature and rated PIV

For full information and applications assistance, contact your Delco Radio representative.

Newark, New Jersey
1180 Raymond Boulevard
Tel: Mitchell 2-6165

Chicago, Illinois
5750 West 51st Street
Tel: Portsmouth 7-3500

Santa Monica, California
726 Santa Monica Boulevard
Tel: Exbrook 3-1465

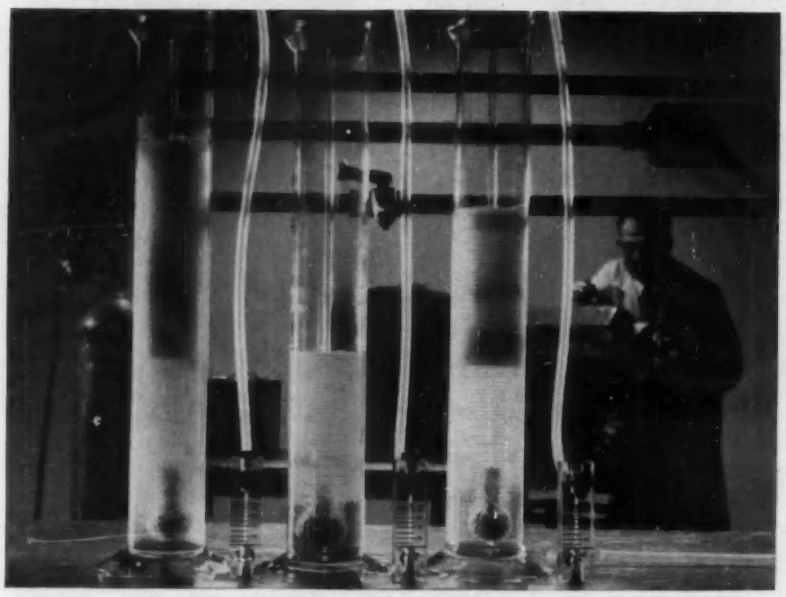
Division of General Motors • Kokomo, Indiana

DELCO RADIO
DEPENDABILITY
RELIABILITY

DOW READIES LUBRICANTS FOR NEW POWER TRAIN DESIGNS

What's the next step in the evolution of the power train? Smaller torque converters . . . transmissions that can carry greater loads . . . or, the transaxle? Whichever way design specialists dictate, more efficient lubricants will be needed to carry the load.

Present realistic plans for the cars of the near future include at least three possibilities for power transmission improvement. One is a small conversion unit designed to transmit the same torque as today's transmissions. Another is a transmission about the same size as the present ones that will deliver much greater torque output. The third is the transaxle—rear-end transmission and axle combined. The practicality of all these depends largely upon the development of denser, more versatile lubricants.



More efficient transmission fluids, now under development at Dow, will be needed for future power transmission improvements.

This fluid must maintain its lubricating quality and the proper viscosity over a wide temperature range. Normal operating temperature in today's transmissions is around 275°F., so the lubricant must not "thin out" at that temperature. But it can't be too thick when it's standing idle at –10°F., either. The viscosity also determines the load this fluid is capable of carrying. Because of small viscosity changes with varying temperatures, synthetic lubricants outperform mineral oils in accommodating heavy loads over a wide range of temperatures.

Then, there's the compatibility factor. This fluid must have no harmful effect on other materials used in transmissions. It can't damage rubber, corrode or otherwise attack various metals. And it must be compatible with people, too. The toxicity of any chemical used in this fluid must be low so that it will have no adverse effect on the health of the people who come into contact with it. Lastly, after such a fluid is developed, it must be reasonable in cost and cause no special problems in producing, handling or installing!

Although this sounds like a nearly impossible assignment, Dow researchers have high hopes of fulfilling it.

Months of intensive developmental work with many different types of chemicals and fluids have given Dow a rich background in synthetic lubricants. The men of the Dow Automotive Chemicals Laboratories invite automotive engineers to consult with them.

ANTIFREEZES ANONYMOUS

The casual visitor in Dow's Automotive Chemicals Laboratories might well wonder, why all the activity on antifreeze? The answer is simply that Dow is keeping ahead of the cooling system requirements of the next model year. More and more heat is generated in today's high compression engines, thus more and more demands are made on the cooling system—and the antifreeze that protects it.

That's why Dow continually tests such factors as corrosive effects on metal, foaming and seep characteristics. Concurrently, research is being carried out on new liquids for ebullient cooling systems that may enable excess engine heat to be used to power a generator. Many of these "antifreezes anonymous" will never get beyond the laboratory, but they're all helping to develop better antifreezes for the cars of the future.

★ ★ ★ ★

For more information about the chemicals discussed in this advertisement, write to us. THE DOW CHEMICAL COMPANY, Midland, Michigan, Chemicals Merchandising Department 905EN12.

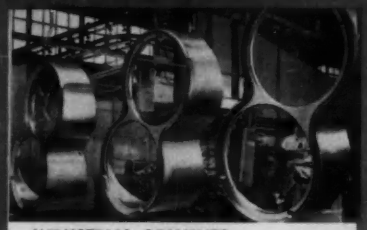
Versatile polyurethane foam now pads seats, may make long wearing tires.

CHEMICAL "INSIDERS"

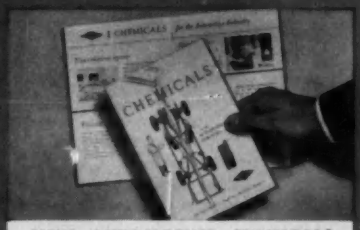
Most Dow automotive chemicals are used in the mechanical areas of the car—the transmission, cooling system or brake cylinder.

Polypropylene glycol, however, one of Dow's polyols, gets inside the car where the people are. It's used to make polyurethane foam, a cushioning material. In the future, entire seat assemblies may be formed of this soft, yet tough and rigid material. Polyurethane foam, in much more dense form, may eventually be used to make pneumatic tires with a service life of several hundred thousand miles!

DOW CHEMICALS...
now at work in the automobile industry



INDUSTRIAL SOLVENTS
Dow Trichloroethylene in three grades and Perchloroethylene speed degreasing. Methylene Chloride tackles stripping problems. Chlorothene® delivers safer, more effective cold cleaning.



NEW AUTOMOTIVE CHEMICALS BOOKLET—Brand new 32-page booklet describes the complete line of Dow chemicals for auto industry and Dow's Automotive Chemicals Development Laboratories. Send for free copy now!

BRAKE FLUIDS
Dow, with its specialized knowledge about the chemicals used in brake fluids, is helping to win the high heat battle. Dow's heavy-duty brake fluid formulations solve many problems.

CAUSTIC SODA
Here's a real workhorse, found in many an auto plant. Formulations made with Dow Caustic Soda serve as paint strippers and metal cleaners . . . help keep waste disposal costs in line.

DOW CHEMICALS basic to the automotive industry
Synthetic Lubricants • Oil and Gas Additives • Antifreeze
Magnesium • Calcium Chloride • Polyols • Glycols
Hydraulic Fluids • Paint Removers • Lubricants • Caustic Soda
Plastic Molding Materials • Paint and Coating Materials

THE DOW CHEMICAL COMPANY
Midland, Michigan

DOW

with re-design 'rithmetic

One flat spring now does the work previously required of the six parts shown—and greatly simplifies assembly, too. This single multi-purpose spring (a) holds a carbon brush in a rheostat, (b) applies pressure on the wire windings, (c) provides friction detent action, (d) acts as a retainer on the rotating shaft.

How did this come about? The maker of the rheostat undertook a complete redesign analysis, called in an A.S.C. Spring Engineer when it concerned the spring.

Early consultation with A.S.C. springmakers in new or redesign projects gives greater range to plans, safeguards against high production costs. Our booklet, "Designing Springs for Performance," may help you. Write for your copy.

8902

Associated Spring Corporation **General Offices: Bristol, Connecticut**

Wallace Barnes Division, Bristol, Conn. and Syracuse, N. Y.
B-G-R Division, Plymouth and Ann Arbor, Mich.
Gibson Division, Chicago 14, Ill.
Milwaukee Division, Milwaukee, Wis.
Raymond Manufacturing Division, Corry, Penna.
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Cleveland Sales Office, Cleveland, Ohio
Dunbar Brothers Division, Bristol, Conn.
Wallace Barnes Steel Division, Bristol, Conn.

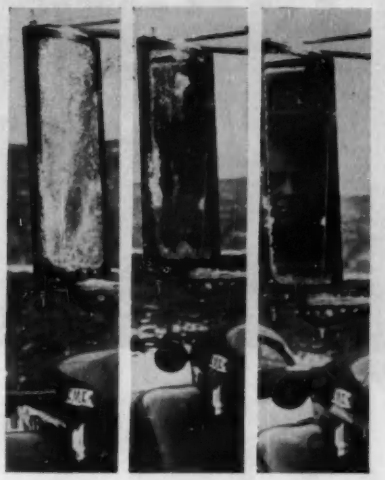
Canadian Subsidiary: Wallace Barnes Co., Ltd., Hamilton, Ont. and Montreal, Que. Puerto Rican Subsidiary: Associated Spring of Puerto Rico, Inc., Carolina, P.R.

THIS IS GLASS

A BULLETIN OF PRACTICAL NEW IDEAS FROM CORNING

NEW! A MIRROR THAT MAKES HEAT TO BEAT SLEET

You're jockeying a big trailer-truck along a winding road in New England. It's winter and you run into a real storm—a mixture of snow, rain, sleet. You flip a switch and . . .



Your outside rear-view mirror is *clear* in a matter of minutes. From a heavy coating of ice to *all* clear is only a matter of five minutes, even at −20°F.

The mirror, as you might guess, isn't just ordinary glass. It's one of Corning's PYREX brand glasses, and on its surface is an electrically conductive coating that's permanently fired in.

This coating (a metallic oxide) is what turns your mirror into a *heating* element when a current is applied. The heat melts ice and snow, prevents fog or drizzle from condensing on the surface.

If you use EC (electrical-conducting) glass for self-defrosting mirrors you get a bonus, since the coating also provides a non-glare surface.

But don't go away just because you gave up dreaming about driving a truck-and-trailer years ago. This PYREX® electrical-conducting glass comes in a wide choice of applications.

For example, there are some enterprising people who build radiant heaters, both portable and permanent, around such glass panels.

Comfort, safety, and convenience are the big selling points. Comfort because a panel of EC glass is an area *heat* source putting out long waves. Safety because there are no exposed wires or moving parts. Convenience since you have no burning, no need to do extensive remodeling in order to install it.

These same reasons have made PYREX brand radiant heating units attractive to industry—for heating, drying, curing, baking.

And, if you turn a panel of this glass *around*, it becomes an infrared reflector you can see through—blocking heat but still passing about 75% of the visible light.

Facts? Ask for PE-34, a 4-page data sheet, and/or PE-60, all about industrial heating units. Please use the coupon.

HOW NOT TO FOUL UP THE WORKS

It's really very simple: If you're using spun insulation in electric motors, you have to keep the stuff from falling into the moving parts and fouling up the works.

Two things to keep in mind when selecting a material for this application: (1) It has to stand up to quite a bit of heat. (2) It *can't* be a conductor.

Some materials that are good insulators can't take the heat. Others function well at high temperatures but are not insulators.

Glass solves both problems. So, people who make electric motors build them with wedges made from PYREX brand glass No. 7740. (We supply the glass in rod form.)

This particular PYREX brand glass offers a number of useful characteristics. It is corrosion resistant and has a linear coefficient of expansion of 32.5 x 10^{-7} in/in between 0° and 300°C. Dielectric properties at 1 Mc and 20°C. are as follows:

Power factor	.46
Dielectric constant	4.6
Loss Factor	2.1

Wedges made from glass rod support spun insulation in electric motors. Glass is non-conducting and able to stand high temperature without deforming.

You can get PYREX brand glass No. 7740 in a variety of forms—pressed ware, blown ware, plate, tubing, rod and panels.

Mechanical, thermal, electrical, and chemical properties of this glass and 27 others are spelled out in Bulletin B-83. Check the coupon for a copy.

PLUMBING FOR POSTERITY

An increasingly popular fixture in labs, hospitals, schools, chem plants, and photo-engraving shops is the glass drainline.

With good reason. Glass drainlines are fashioned from PYREX brand glass No. 7740.

This is the glass that ends your worries about corrosion. For example, if you were disposing of waste hot hydrochloric acid, your PYREX pipe would still be around at the end of 200 years.

And glass is smooth; very little chance for block-up in the pipe. If such does occur, however, you can spot the exact point and take corrective action, without having to take down the whole system.

In fact, almost anything made from PYREX brand glass No. 7740 will be around for quite a while because this glass is able to cope with thermal shock and physical knocks, too.

Available in many forms—tubing, rod, pipe, plate, and all kinds of shapes.

Fill in the gaps in your files with these basic references: PE-30, all about glass drainlines; IZ-1, design considerations in glass. Any or all, free. Use the coupon.

MORE ON PYROCERAM*

Developments in our new crystalline materials made from glass are treated at length in the third Pyroceram Progress Report. See coupon.

*Trade Mark

CORNING MEANS RESEARCH IN GLASS

CORNING GLASS WORKS 40 Crystal St., Corning, N. Y.

Please send me: ☐ PE-60, booklet on heating units; ☐ B-83, "Properties of Selected Commercial Glasses"; ☐ IZ-1 Design Manual; ☐ PE-30 Drainline Manual; ☐ Pyroceram Progress Report No. 3; ☐ PE-34, "Corning Flat Glasses."

Name..... Title.....

Company.....

Street.....

City..... Zone..... State.....

Do You Have Aluminum Cylinder Head—aches?

For a number of years Eaton has been working on the special problems posed by the design and production of aluminum engines—particularly in the field of hydraulic lifters, tappets, valves, valve seat inserts, and replaceable valve guides.

The knowledge and data developed by Eaton research and experimentation are at your disposal. Eaton engineers will welcome an opportunity to make suggestions that may be just the "cure" you're looking for. Why not call on us now.

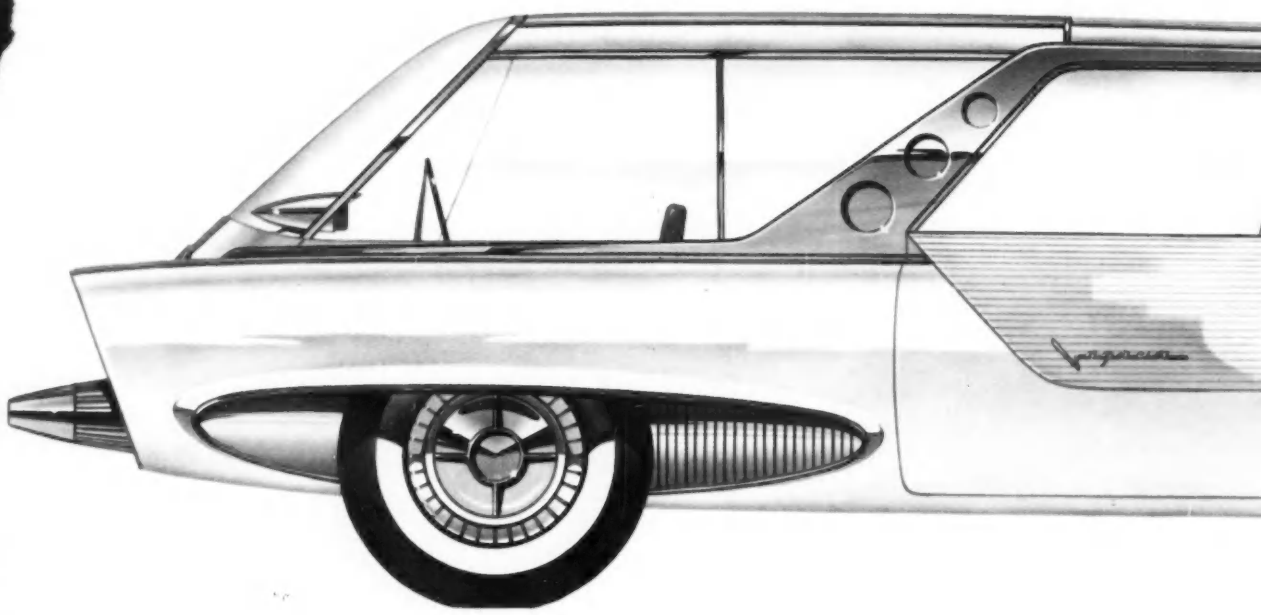
EATON

SAGINAW DIVISION
MANUFACTURING COMPANY
9771 FRENCH ROAD • DETROIT 13, MICHIGAN

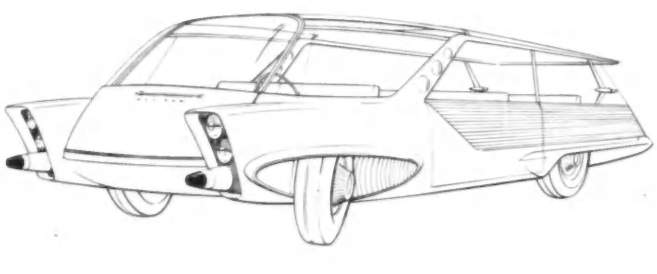
Will you be building this car?

...using the highest-quality aluminum

now being produced in America?



The Waimea *(Wy-may-*



The Waimea is a Kaiser Aluminum design tha
design advantages of aluminum to achieve maxi
located aluminum engine, tunnel-free aluminum f
panels—*all aluminum!*

And you may be certain that you will be bui
Waimea, or components suggested in its design.
and more aluminum is being designed into Ame

"What Is The Difference In Aluminum Fr

-may-ah) an all-aluminum car

design that incorporates the
hieve maximum utility. Front-
aluminum floor, roof and body

will be building cars like the
its design. Every year, more
d into American automobiles.

Ravenswood–source of highest quality aluminum

Ravenswood, West Virginia, is the location of what is perhaps the most *quality-minded* aluminum plant anywhere—the new Kaiser Aluminum reduction plant and rolling mill. Both by location and by layout, this plant is ideally situated to supply you the highest-quality aluminum available today.

Ask us, if you like, this question:

minum From Ravenswood?" (and please turn to back page)

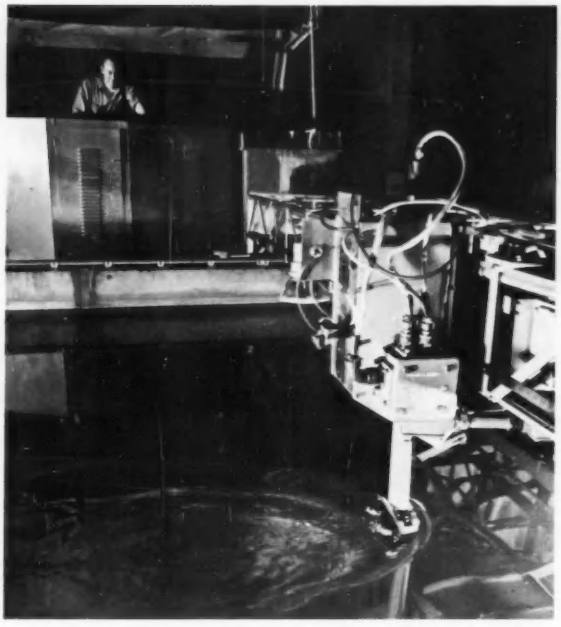
KAISER ALUMINUM

A unique concept in customer service

Kaiser Aluminum from

Ravenswood

Quantometer Analysis—verifies absolute correctness of alloy composition in the molten metal prior to casting.



Ingot Sonic Testing—detects any internal irregularities in the metal, assures conformance to production standards.

Production Quality Assurance

Six quality control checks are key elements in the aluminum production process at the Ravenswood mill. Two of these quality assurance steps are shown here. Others are: vacuum freeze test, surface characteristics test, in-process fabrication check and final inspection.

These unique quality control standards are Ravenswood's way of making sure that the plant turns out exactly what the customer ordered.

Prompt Delivery

One Day Delivery, 186 miles to Cincinnati, 226 miles to Cleveland, 330 miles to Detroit! With direct access to fast truck and rail transportation, Kaiser Aluminum's Ravenswood, W. Va. plant is strategically located to give fast service to the automotive industry for products such as coiled sheet, flat sheet and blanks.

End-Use Performance Checks

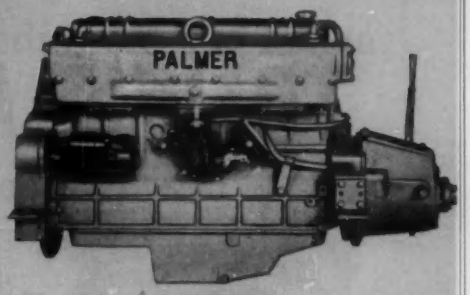
In another unique Ravenswood service, each customer's metal is checked for performance *according to the customer's own fabrication methods.* Before the metal leaves the mill, each order is tested in facilities which duplicate, on a pilot scale, the production equipment in customers' plants.

The full resources of Kaiser Aluminum's Ravenswood plant are yours to draw upon. Let us give you specific details of how Ravenswood availabilities and service can benefit *you.*

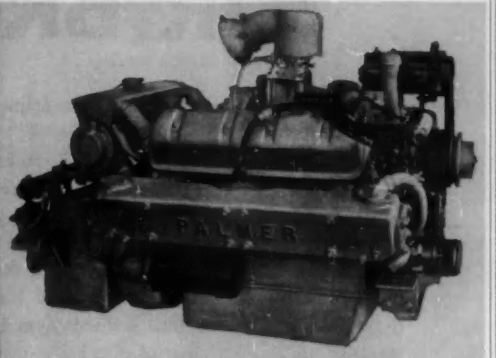
CALL

KAISER ALUMINUM

Kaiser Aluminum & Chemical Sales, Inc., Automotive Industry Division, I.B.M. Building, Detroit 2, Michigan. Phone TRinity 3-8000.



This 32-ft. custom built cruiser has a 28 mph. top speed. Power is provided by pair of International 6-cyl. engines with 264 cu. in. displacement.



Big sightseeing boat makes 30 minute full throttle trips at 30 mph. Power: two International UV-461 V-8 engines shown above.

R. C. Bolling, President, the Palmer Engine Co., Cos Cob, Conn.

"Sales up over 500% in five years after switch to International power"

Here's the full report on the experience of a 72-year-old company in search of ideal power as related by President R. C. Bolling:

"As the oldest marine engine manufacturer in the country, The Palmer Engine Co., has progressed from construction of complete marine engines in small volume to the present-day utilization of mass-produced engine assemblies adapted to marine purposes in order to bring the boating public highly engineered, economical marine engines to suit current boating requirements.

"In this process of evolution, Palmer has used a number of mass-produced industrial and automotive assemblies, but we never experienced such success as that which came our way after we began using International engine assemblies five years ago. Our sales have increased over 500% in five years and the boating public, both commercial and pleasure, has come to know that an International-Palmer marine engine means the utmost in power, dependability and economical operation. We look forward to the future with confidence that our International marine engine sales will re-double many times and that our International diesel marine sales will soon become a big factor in the industry."

See the Palmer exhibit at the National Motor Boat Show, New York Coliseum, January 13-24, and call or write International Harvester Co., Engine Sales Dept., Construction Equipment Division, Melrose Park, Illinois, for information about this outstanding 24-model engine line. Power range is 16.8 to 385 max. hp, diesel or carbureted.

INTERNATIONAL®
ENGINES

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers and Bottom-Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

Compressors and accessories by Bendix-Westinghouse

TRUCK MANUFACTURERS

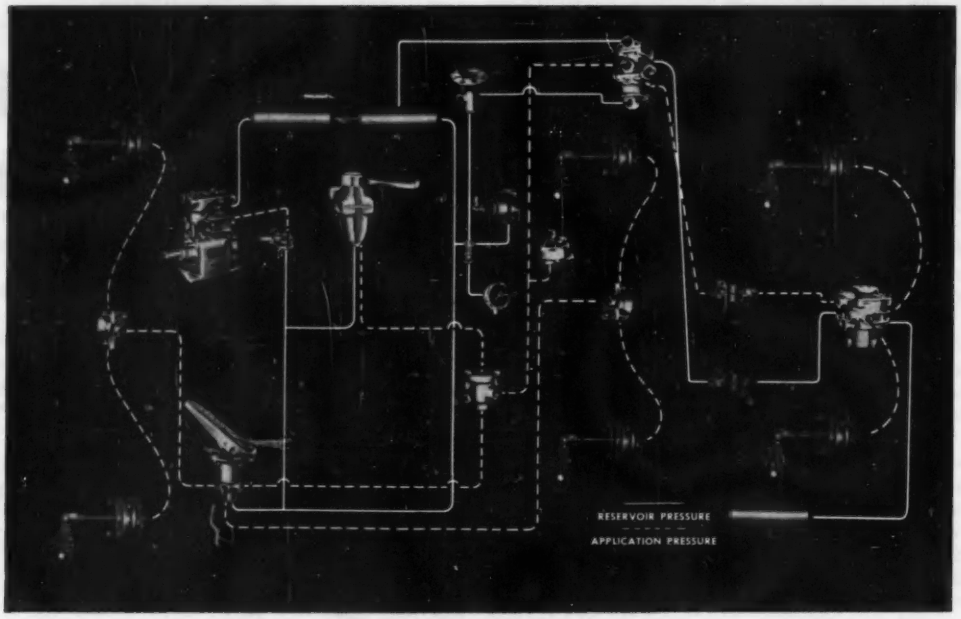
provide top performance at lower cost
with dependable

BENDIX-WESTINGHOUSE AIR BRAKE SYSTEMS!

Your customers gain many outstanding benefits when you equip your new vehicles with *complete* Bendix-Westinghouse Air Brake Systems. Each component of the basic system . . . as well as every optional accessory item . . . has been "*system engineered*" to assure complete operating compatibility for all units . . . an absolute essential for maximum performance of this closely related chain of devices. What's more, they have proved their dependability and overall economy on the toughest test track of all . . . millions of operating miles in service for the largest list of loyal, satisfied customers in the trucking industry. Superior engineering and research have made the name Bendix-Westinghouse *the standard of quality* among truck operators for thirty years . . . make it possible for you to offer your customers the finest air brake equipment available at the lowest life-cycle cost.

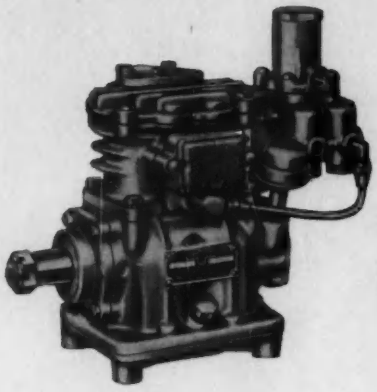
Coast to coast facilities for faster brake service. No matter where your customers' trucks travel they're never far from a Bendix-Westinghouse service outlet. Our nationwide network of Authorized Distributors is made up of *Truck Specialists* with the tools, equipment and stock-on-hand to take care of any brake maintenance and service required—in the shortest possible time, at the lowest possible cost. This alone is a mighty good reason why operators always are ahead with Bendix-Westinghouse Air Brake Systems on your vehicles.

Economical Repair Exchange Service. When Bendix-Westinghouse units require replacement, they can be quickly exchanged at nominal cost for factory-rebuilt devices that include the latest, most up-to-date improvements in design and construction. What's more, these low-cost Bendix-Westinghouse factory-reconditioned items carry the same warranty as brand-new units.

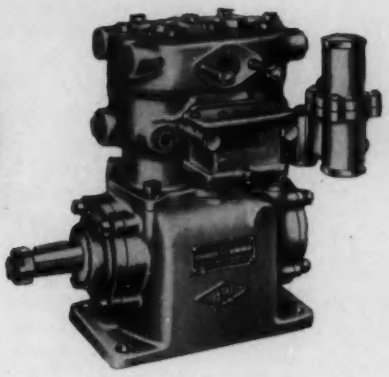


More trucks and buses are equipped with Bendix-Westinghouse Air Brake Systems than all other makes combined.

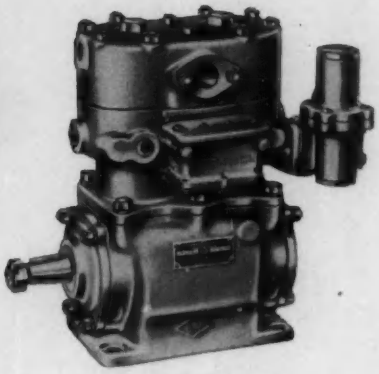
Compressors and accessories by Bendix-Westinghouse



AIR COOLED TU-FLO 300

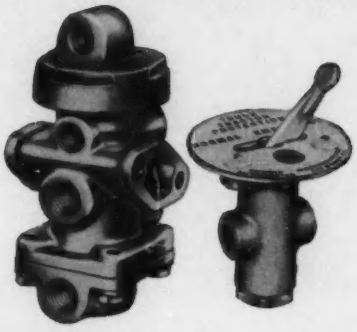


AIR OR WATER COOLED TU-FLO 400



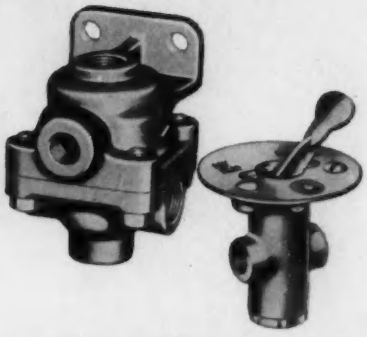
WATER COOLED TU-FLO 500

TU-FLO COMPRESSORS assure outstanding braking performance for all trucks, tractors, buses and off-the-road equipment: lower discharge temperatures over entire speed range . . . increased air delivery at low and intermediate speeds . . . improved oil control . . . higher maximum speeds . . . no external moving parts . . . and many other advantages.



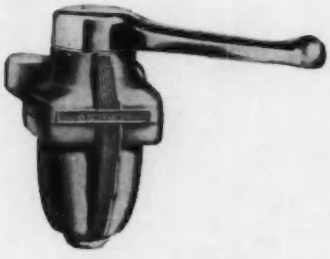
TRACTOR PROTECTION VALVE protects truck or tractor air brake system against loss of air pressure due to trailer break-away, leakage, or improperly connected hose lines. Complies with all current safety regulations.

LOW-PRESSURE INDICATOR warns of any abnormal depletion of air. Buzzer or jewelled light notifies driver instantly when air pressure drops below normal.

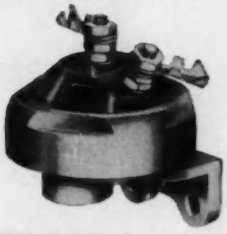


COMBINED LIMITING AND QUICK-RELEASE VALVE with dash-mounted control within easy reach. Offers driver choice of full front-wheel braking in "Dry Road" position or 50% front-wheel braking in "Slippery Road" position.

AIR HORNS that give finest warning signal on the highway. Suited to either cab-roof or under-hood installation. Come in one compact kit with optional hand or foot control.



INDEPENDENT TRAILER-CONTROL VALVE provides highly important independent trailer braking on severe grades, ice, or under otherwise hazardous road conditions. Minimizes "jackknifing."



STOP LIGHT SWITCH—electro-pneumatic device that operates in conjunction with brake valve and stop light by completing electrical connection the instant brakes are applied. No mechanical connections.

ALCOHOL EVAPORATOR effectively protects the air brake system against freezing in low temperature operations. Easily installed, inexpensive to operate.

Bendix-Westinghouse

AUTOMOTIVE AIR BRAKE COMPANY

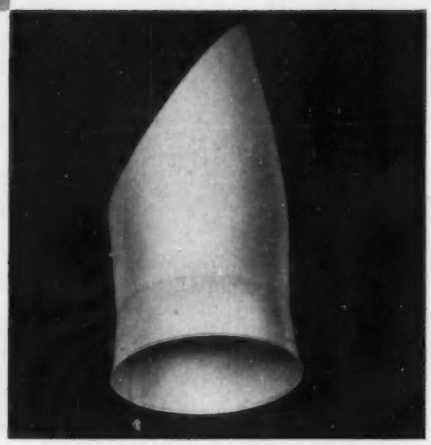
General Offices and Factory—Elyria, Ohio.
Branches—Berkeley, Calif., and Oklahoma City, Okla.

ROHR
advances the state of
MANUFACTURING
art through
RESEARCH

To preserve its role as the world's largest producer of components for flight, Rohr gives high priority to its manufacturing activities. This involves *anticipation* of future customer needs, *evaluation* of those needs in light of Rohr's capabilities, and *implementation* of new techniques and methods when required.

Manufacturing research is typified by explosive forming, illustrated here. Rohr began work on this technique in 1949 and more than 15,000 sound suppressor tubes have been produced using this method. Final forming of the Rohr-fabricated production units is by the Olin Mathieson Chemical Company under a sub-contract. Such research means better products at lower cost to Rohr's customers.

Rohr invites inquiries from men who can contribute to our leadership in the aerospace industry.



WORLD'S LARGEST PRODUCER
OF COMPONENTS FOR FLIGHT

ROHR
AIRCRAFT CORPORATION

CHULA VISTA AND RIVERSIDE, CALIFORNIA

ADVANCED DESIGN PISTONS

By GILLETT AND EATON

for Longer Heavy Duty Service

TROUBLE-FREE with thousands in use

★ Low initial cost ★ Low cost per mile

★ Amazing increase in piston life

★ Maintains new engine power and performance

G and E WIRE INSERTS PUT CAST IRON WEAR IN TOP RING GROOVE

G and E Wire Insert Piston before machining (left) and after ring grooves are cut (right) showing how the steel wire forms a tough wear-resisting surface on both faces of top ring groove. The patented ferrous plug molded in the head (for diesel pistons) prevents burning through head and lengthens diesel piston life!

With the thousands of G and E "Wire Insert" Pistons in use for periods up to 3 years—a phenomenal record for trouble-free operation has been established. The "Wire Insert" greatly reduces top ring groove wear and increases piston life.

The "Wire Insert" piston design—exclusive with G and E—combines all the advantages of aluminum alloy pistons with the long life of steel in the top ring groove lands. No noticeable increase in weight—unequalled for rapid heat flow—and at low cost.

A pre-shaped steel wire is cast into the piston where the top ring is located. When the grooves are machined, the closely spaced wire surfaces form hard bearing areas on top and bottom faces of the groove. Result—reduced ring land wear, longer piston life at lower cost.

as LIGHT as aluminum . . . wears LIKE IRON

VANASIL*

"OIL-ABSORBING" PISTONS FOR GASOLINE AND DIESEL ENGINES

*Gillett & Eaton's trademark for a Hyper-eutectic silicon aluminum alloy

VANASIL Pistons have repeatedly run way over 200,000 miles with only .002" to .005" wear on the top ring grooves. On-the-road ring breakdowns caused by badly worn grooves are almost eliminated because *Vanasil Pistons reduce top ring groove wear up to 75%!* Nothing else compares with the genuine G & E Vanasil—the original Hyper-eutectic silicon alloy, proven by 19 years of use.

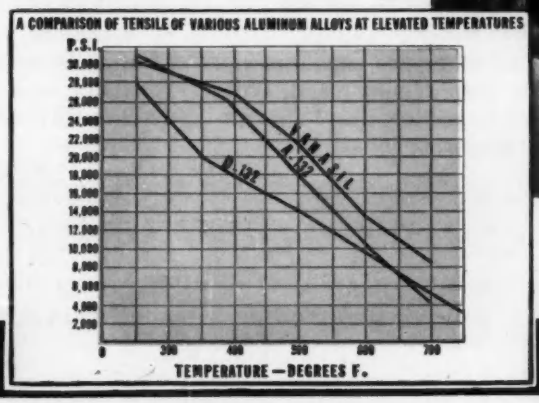
You Get ALL These Advantages Only In

GENUINE VANASIL PISTONS

G & E PROVED Hyper-eutectic Silicon Alluminum Alloy

1. LIGHT WEIGHT—Same as other aluminum alloys.
2. SCORING, SCUFFING MINIMIZED—Because of "Oil Absorbing" microscopic porous texture.
3. LONGER LIFE—30% less friction—30% harder. Greater "hot strength"—see chart at right.
4. TOP RING—Breakage virtually eliminated because of reduced ring groove wear.
5. LOW EXPANSION—Characteristics of Cast Iron.
6. CLOSE CLEARANCES—Fitted with Cast Iron Clearances.
7. SOLID SKIRT DESIGN—No expansion devices required.
8. HIGH HEAT CONDUCTIVITY—Similar to other aluminum alloys.
9. PLATING—No tin or other break-in coating required.

See Gillett & Eaton, Inc.
Booth 103
SAE Engineering Display
January 11–15, Detroit, Michigan



Write for complete information and prices on Gillett and Eaton's Wire Insert and Vanasil longer lived pistons.

"Our 91st Year"

GILLETT and EATON, Inc. 853 DOUGHTY STREET LAKE CITY, MINNESOTA

valve gear for any engine

Hydraulic and Mechanical Tappets (Barrel or Mushroom Type) of Alloy Steel, Hardened Alloy Cast Iron, Chilled Iron, or Alloy Chilled Iron • Push Rods • Adjusting Screws • Retainers

No matter what your valve gear requirements, it will pay you to check with Chicago's Tappet Division. For here you get the benefits of specialized techniques and facilities which, in 25 years of producing tappets and other valve gear, have established long records of trouble-free service . . . verified in over 25 million engines.

Chicago's special staff of tappet engineers can provide complete valve train designs for all types of engines . . . car, truck, tractor, diesel . . . aircraft, outboard, power mower, or industrial.

Their particular skill in development engineering will also prove a valuable addition to your own engineering staff. And the unique manufacturing and precision testing facilities especially developed by Chicago for valve train production provide you assurance of dependability and long life.

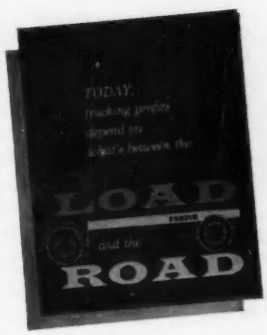
Whatever your valve gear problem, just call Chicago's tappet engineers today. You will find it advantageous to contact Chicago *while you are still in the preliminary design stages.*

THE CHICAGO SCREW COMPANY

ESTABLISHED 1872 • DIVISION OF STANDARD SCREW COMPANY

2701 WASHINGTON BOULEVARD, BELLWOOD, ILLINOIS

The One BIG FACTOR That Increases A Truck's Life!



For the complete story on Parish heat-treated alloy siderails, write for the interesting, illustrated booklet—"Load and the Road."

Commercial vehicles — from off-the-road loggers to transcontinental vans —are being designed to carry heavier loads farther at a faster pace. And the BIG FACTOR that means longer life for many of these vehicles is extra-strength Parish siderails.

Parish alloy steel siderails are *277% stronger* than ordinary carbon steel. Made of heat-treated chrome manganese molybdenum steel, they're the finest combination of modern materials and design know-how. They mean extra strength without extra weight.

Parish siderails absorb shock better, hold their shape better, than do conventional siderails. Misalignments caused by frame warping are almost non-existent. Drive train components last longer. Maintenance costs and downtime are reduced.

That's why some 30 leading truck and trailer manufacturers are now designing their vehicles around Parish heat-treated siderails—the *extra strength* siderails that stay aligned.

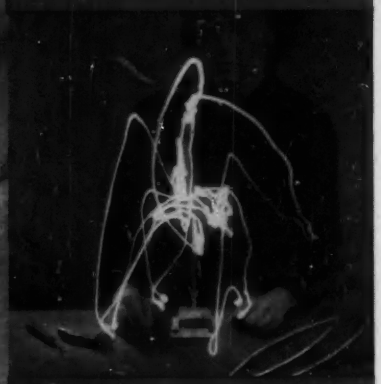
• **DANA PRODUCTS:** Transmissions • Universal Joints • Propeller Shafts • Axles • Torque Converters • Gear Boxes • Power Take-Offs • Power Take-off Joints • Rail Car Drives • Railway Generator Drives • Stampings • Spicer and Auburn Clutches • Parish Frames • Forgings.

PARISH PRESSED STEEL

DANA Division of Dana Corporation — Reading, Penna.

New ROL-PAK slips over dispenser rail, tape strips off in seconds. Printed, color-coded tapes identify ring type and size. All or part of ROL-PAK may be used at one time.

TIME EXPOSURE COMPARISON



Old stack-rod set up requires two hands. Uses up valuable production time.

New ROL-PAK set up is far simpler and quicker; requires only one hand.

New Truarc ROL-PAK speeds ring assembly, handling

ROL-PAK* is a new method of pre-stacking retaining rings for faster, more economical assembly on production lines. Pre-stacked on a color-coded tape, the rings are quickly identified by type and size. Available to users of Truarc Retaining Rings exclusively, ROL-PAK provides production flexibility, and allows faster and more efficient assembly set-up.

On your production line, ROL-PAK slips over the dispenser rail ready to use. The pressure sensitive tape is stripped off in seconds. With the old stack-rod packaging, by contrast, an operator had to remove the cotter pin, hold the bottom rings on the rod to prevent their slipping off then carefully position the rod on the dispenser rail . . . a much more time consuming, less-efficient method.

Here are important ROL-PAK advantages for you to consider: *Faster assembly* because of quicker, easier loading as illustrated above. *Easier identification* of ring size and type, right on the printed, color-coded tapes. *Greater flexibility* since all or part of ROL-PAK may be used. *Easier handling, storage* with no protruding stack-rods.

ROL-PAK is available in Truarc Series 5103 Crescent® rings, 5133 E-rings and 5144 Reinforced E-rings in most widely used sizes. All present types of Truarc ring dispensers may be easily converted to ROL-PAK.

The design advantages of Truarc retaining rings, have led to their ever increasing use in production of products of all kinds. The new Waldes Truarc Assembly Tool Catalog AT 10-58 covering assembly tools, pliers, applicators, dispensers and grooving tools belongs in your files—write for it. And on special application problems, Waldes Truarc engineers will be glad to help. Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.

*Pat. Pending ©1959 WALDES KOHINOOR, INC. 9.10

WALDES
TRUARC®
RETAINING RINGS
Waldes Kohinoor, Inc., Long Island City 1, N. Y.

TRUARC RETAINING RINGS . . . THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS

Some Ideas

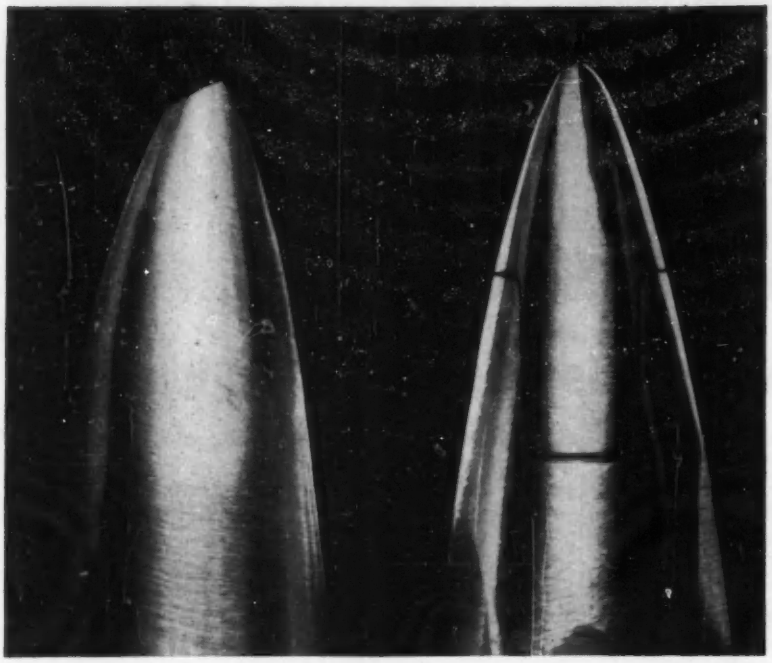
for your file of practical information on drafting and reproduction from

KEUFFEL & ESSER CO.

It seems that today's rugged drafting films, such as K&E Herculene and Stabilene, can dish out punishment as well as take it. Smooth and comfortable as they are to work with, these films can blunt the points of some ruling pens after about 80 hours of drafting – though their effect on pencils is no more abrasive than any other material. For pen-and-ink work on Mylar-based films, K&E offers a simple solution . . .

Tough Pens for Tough-Toothed Films

Two new K&E drawing instruments – the Paragon® Drop Bow Pen No. 813H and the Paragon Bow Pen No. 816H – are now part of the well-known Paragon *Red Tip* line. Both are pointed with Carboloy, hardest of metals. The Carboloy insert, butt-welded to the pen's blades, forms a tip that resists the subtly abrasive film, keeps its shape for hundreds of hours of neat, sharp, almost effortless inking.



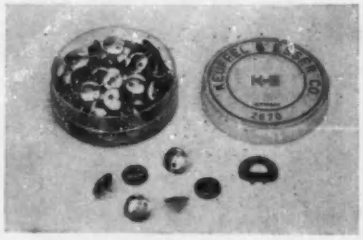
Wearing power of new Carboloy-tipped K&E ruling pens was dramatically proved in a recent test series by a governmental agency. Results of our own tests are shown above. At left: plain steel tip after tracing 500 feet on Mylar®-based Herculene® Film. At right: Carboloy point of Paragon *Red Tip* pen after 5,000 feet – about a year's work – on the same material. If you'd like to see a more detailed report, we'll gladly send it to you, on request.

Days Between Refills

You can letter continuously – for remarkably long periods – without refilling the new Leroy® Reservoir Pen by K&E. Its

airtight cartridge – made of non-porous, transparent plastic – holds a liberal supply of your favorite waterproof India drawing ink. This pen is self-cleaning – fitted with a tiny weighted needle in the feed tube. If the pen has been idle for an hour or so, simply shake it lightly and vertically to actuate the needle, break up and remove any particles which may have settled in the passage. Smooth ink flow resumes immediately. You'll find the needle's efficient mechanical cleansing action helpful when washing the pen, too.

The Leroy Reservoir Pen (No. 3230) comes in seven sizes, 00 to 5. The points are specially designed for vertical use: when held in Leroy Scribers, these pens glide easily over paper or film surfaces, produce sharp, crisp, uniform lettering that reproduces beautifully. Leroy Reservoir Pens are available individually or in sets of seven (No. 3230S). A new K&E brochure gives full details. Ask us for it, today.



Easing A Sticky Situation

Do you sometimes have a tack-up problem where sticky adhesives don't do the job? Then maybe you need a good thumbtack (almost a forgotten item in the draftsman's kit). But K&E still has thumbtacks, and they are the best you can buy. They're made of nickel-plated steel, and have thin, streamlined heads that permit drafting machines to slide easily over them.

From thumbtacks to lumber crayons, there are a thousand and one other items almost forgotten, perhaps, but which K&E carries to serve every draftsman's need – as infrequent as that need may be.

Your nearby K&E dealer will be pleased to demonstrate these helpful drafting room items. Stop in and see him, or clip and mail the coupon below for more information.

Herculene, Stabilene, Paragon and Leroy are registered trademarks of Keuffel & Esser Co.

KEUFFEL & ESSER CO., Dept. SJ-12, Hoboken, N. J.

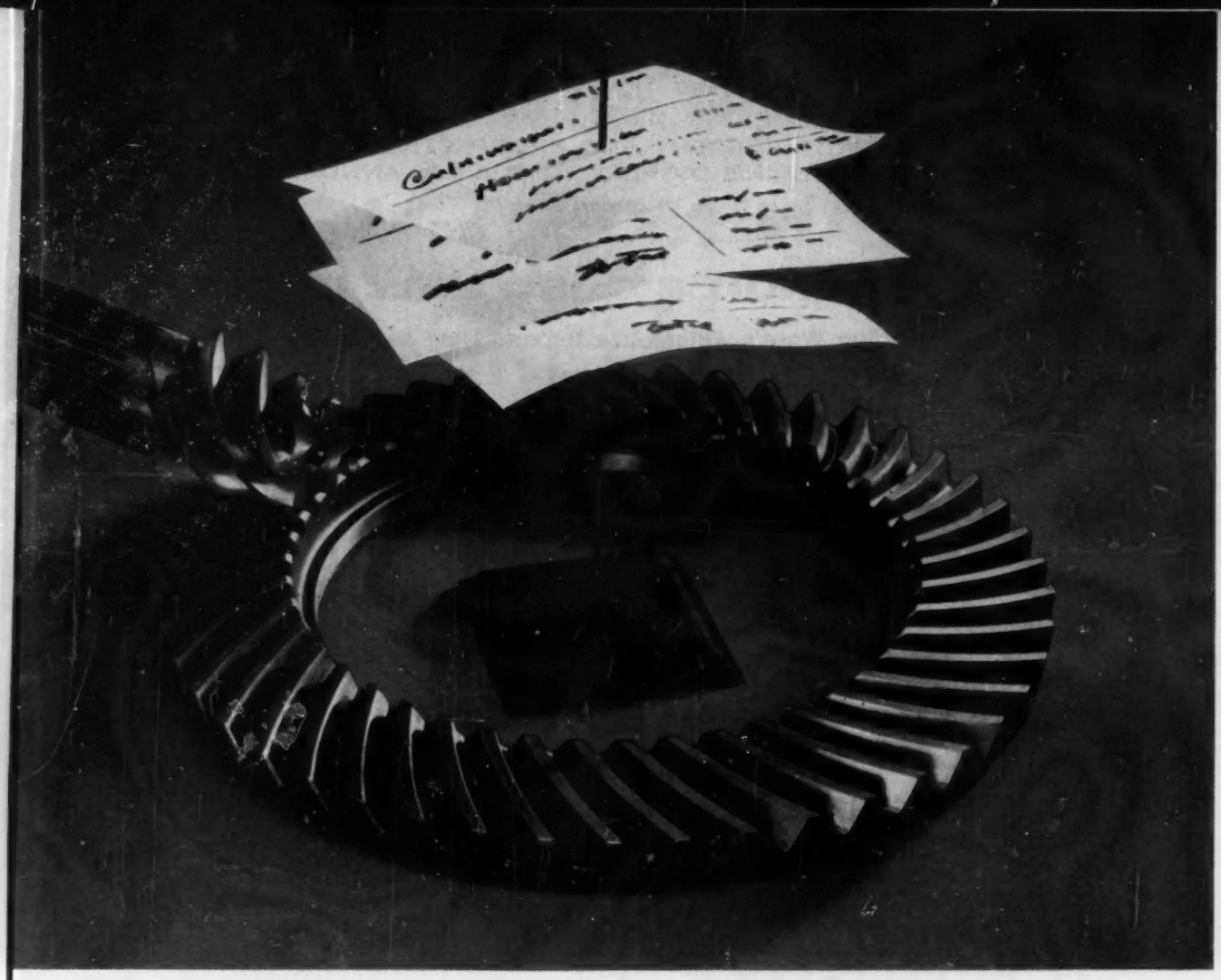
I'd like to know more about:

- ☐ New K&E Paragon Ruling Pens with long-wearing Carboloy tips.
- ☐ New K&E Leroy Reservoir Pen.

Name & Title_____

Company & Address_____

_____ 2003



GEAR BILLS come in "THREES"

No matter where you buy them, every gear order automatically involves three costs.

1. *The initial cost of the gears themselves*
2. *The cost of installation*
3. *The cost of service*

The second two bills—installation and service—can run much higher than the initial purchase price. That is particularly apt to be true where corners are cut to make the purchase price low.

We always strive to produce "Double Diamond" Gears at a low initial price. Even more important, they are made to standards which lower the *total* gear cost—purchase price *plus* installation *plus* service. It is *that* figure that interests us most. If it interests you, too, you may find it worth your while to consult a "Double Diamond" engineer next time you're wanting gears of the many types we make.

EATON

AUTOMOTIVE GEAR DIVISION
MANUFACTURING COMPANY
RICHMOND, INDIANA

GEARS FOR AUTOMOTIVE, FARM EQUIPMENT AND GENERAL INDUSTRIAL APPLICATIONS
GEAR-MAKERS TO LEADING MANUFACTURERS

SPECIAL NOTICE—
TO ALL PAST, PRESENT AND PROSPECTIVE EXHIBITORS IN THE ENGINEERING DISPLAY AT **S.A.E.'s** ANNUAL MEETING:

PLAN NOW FOR YOUR MOVE TO DETROIT'S COBO HALL IN 1961...

Here's What Ward's Automotive Reports Have to Say About the Move:

SAE Annual Convention Booked at Detroit's Cobo Hall, 1961-1965

The Society of Automotive Engineers has engaged Detroit's Cobo Hall for its annual conventions from 1961 through 1965.

The move will give SAE the opportunity of sponsoring what could be the most prominent automotive engineering display in the country and would undoubtedly add authority to Detroit's standing as the motor capital of the U.S. and heart of the industry.

The modern Detroit Civic Center site, currently under construction in the city's bustling downtown waterfont section, is scheduled for opening in August, 1960.

January Dates Set

The SAE business dates firmed up at this time for the 1961-1965 conventions are: 1961 – Jan. 9-13; 1962 – Jan. 8-12; 1963 – Jan. 14-18; 1964 – Jan. 13-17; 1965 – Jan. 11-15.

Cobo Hall will provide the SAE sessions with 400,000 sq. ft. of exhibit space contrasted to just over 10,000 sq. ft. at Detroit's Sheraton-Cadillac Hotel, where the January meeting was held this year.

Membership Swells

It would not be unlikely that SAE will rent exhibit space during its convention to various trades connected with the auto industry for individual expositions.

Textile manufacturers and leather firms would be able to set up equipment to detail their fabric-making processes; rubber makers could show how a tire is made; similar exhibits could be allotted to the replacement parts business; car manufacturers, themselves, might devise cutout working models of engines or even entire automobiles or trucks in simulated motion.

The whole SAE affair could, in fact, house minor conventions for just about every engineering trade allied with the automotive and accessories business.

SAE's expanding membership has been a primary factor in the society's search for larger convention quarters. As of Jan. 1, there were 23,000 members, with the count swelling every month.

Excerpt—Wards Automotive Reports
March 30, 1959

Why Not an Automotive Engineering World's Fair at Detroit's Cobo Hall

Such a structure as Cobo Hall, situated as it is in the manufacturing heart of the auto industry, could be a perfect place for a gigantic technical exhibition —practically a world's fair of automotive engineering — sponsored by the Society of Automotive Engineers.

What a progressive industrial advance would be made by SAE's promotion of a colossal automotive engineering convention-exhibit, particularly with such a valuable location as Cobo Hall available!

Suppliers Could Participate

Parts makers, rubber and tire firms, textiles and leather companies, the metals trades – all of these groups and everyone else with a piece of automotive equipment to show or sell could be provided with the space sufficient to properly present and if necessary, demonstrate his advanced design product.

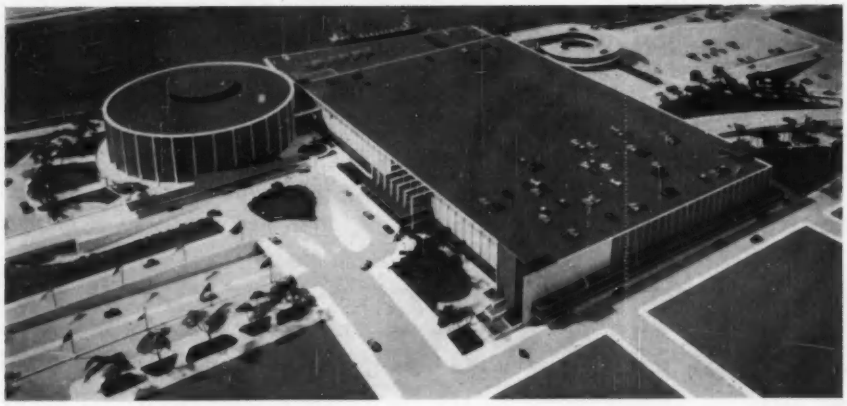
Cobo Hall's foundations are strong enough to hold heavy equipment such as huge body element stamping presses and various types of rugged metal working machines. The machinery could turn out stampings or tools right in the exhibit area.

If SAE could come up with such a spectacle it would certainly sweep crowds into Detroit, throngs from various areas of industry and business. The affair could, in fact, house minor conventions for every technical trade allied with the auto and accessories field.

SAE selected Cobo Hall for 1961 and subsequent conventions not only because of its vast exhibit area but for other accommodations as well, including several meeting rooms that seat over 500 persons and a banquet and adjacent room that can hold and serve over 5,000. *Excerpt*—Ward's Automotive Reports

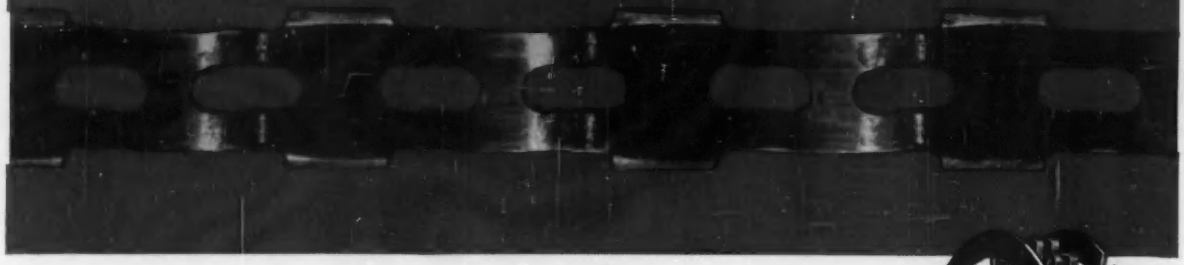
HERE'S WHAT YOUR 1961 AUTOMOTIVE MARKET PLACE LOOKS LIKE:

Details will be released in January



Exclusive Design

OF SEALED POWER STAINLESS STEEL OIL RINGS assures an end to oil ring clogging



Here you see a section of Sealed Power's stainless steel oil ring after fifty thousand miles of service. Note how clean the surface, how open the vents.

The stainless steel used in this Sealed Power oil ring is not affected by the acids and gases of internal combustion; does not pit or corrode; carbon does not cling to it, varnish doesn't build up.

Thus the main cause of carbon build-up and consequent oil ring plugging is eliminated. Because of the self-expanding design, the oil vents in Sealed Power stainless steel oil rings are not blocked by springs in back of them. They permit the free flow of oil back to the crankcase.

OTHER KEY FEATURES

- They hold their fit in the cylinder
- They stop smoking even under high vacuum operation
- They are side-sealing
- They are quick seating
- They are chrome-plated for long life

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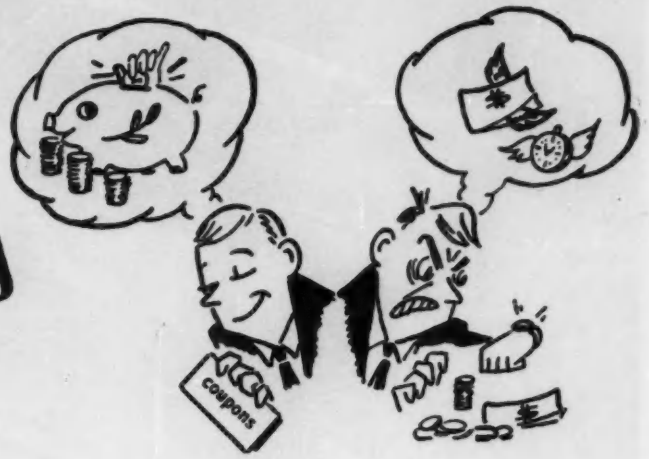

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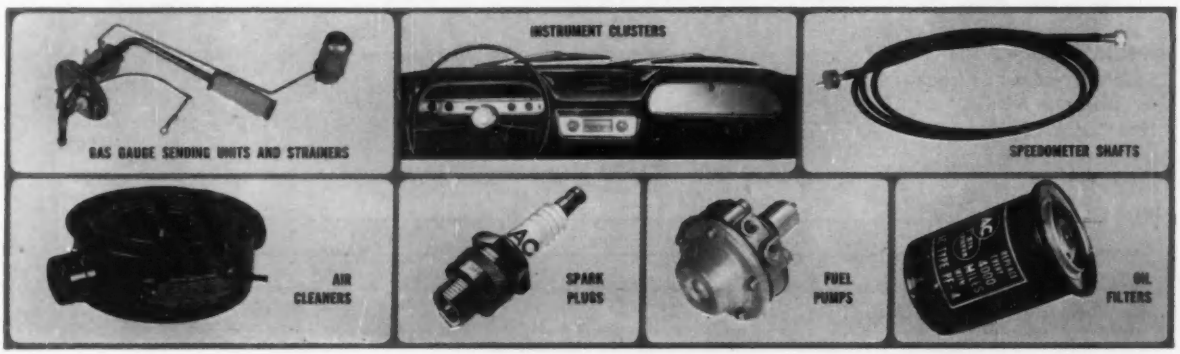

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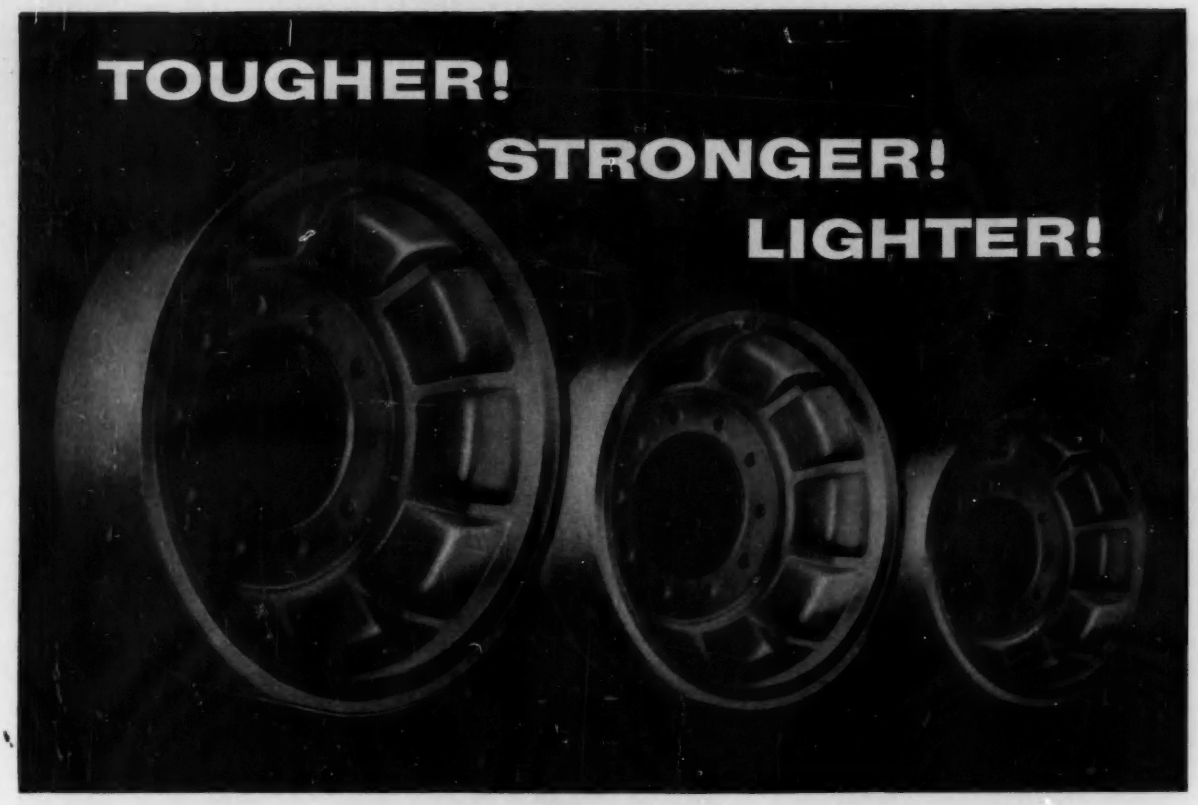

They're Bridgeport Forged Aluminum Wheels

The Army's new M-60 battle tank, produced by Chrysler Corporation, will combine the most advanced design and exceptional fire power of any known armored vehicle. A key factor in its superiority is greatly increased mobility achieved through weight reduction.

Close to a ton of dead weight has been eliminated in the revolutionary change from steel to aluminum wheels. The first to be used on any tank, the wheels are forged using a Bridgeport design which produces the ribs and stiffener ring as an integral part of the forging. Rugged, yet light, they meet the toughest operating demands and Ordnance specifications.

These Bridgeport forgings are but one example of the growing use of aluminum in defense equipment. Its lightness, strength, and corrosion resistance make it the natural choice for everything from "tent pegs to missiles." At present, there are no less than a minimum of 336 actual or potential applications of aluminum military equipment.

Whatever *your* aluminum needs . . . whether forgings, extrusions, or sheet, you can count on Bridgeport's ability to meet your most exacting requirements. To tap Bridgeport's reservoir of experience and knowledge, just call our nearest office, or write direct to Bridgeport Brass Company, Bridgeport 2, Connecticut.

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Specialists in Metals from Aluminum to Zirconium

This nut saved money because we made the hole

You're looking at one of the nuts that fits a casing bolt on a General Electric steam turbine. These nuts have to be of a special alloy steel because they are highly stressed at operating temperatures. The steel must have very high "creep strength"—keep its strength and dimensions at high temperature.

The General Electric Company was making these nuts from alloy steel bars. That was expensive because it meant drilling a large hole as the first operation.

Timken Company metallurgists said they could make seamless steel tubing of the same analysis and properties. And with the hole already there, this would eliminate the rough drilling operation—save a major machining cost.

We furnished Timken seamless steel tubing of the proper size so that after threads were cut, and the castellated heads machined, the nuts were finished up to the specified dimensions. And because Timken steel tubing is rotary pierced, it has the forged quality to give these nuts the strength they need.

This is another of the hundreds of tough steel problems that Timken Company metallurgists solve in every corner of industry. Many of these problems are apt to be much like yours. Why not let our 40 years of steelmaking experience work for you? Have your next steel problem stamped "Solved" in jig time. Call in Timken Company metallurgists. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

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1. Quality that's uniform from heat to heat, bar to bar, order to order
2. Service from the experts in specialty steels
3. Over 40 years experience in solving tough steel problems

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